

**STATE OF UTAH**  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

FORM 3

AMENDED REPORT



<b>APPLICATION FOR PERMIT TO DRILL</b>						1. WELL NAME and NUMBER CW-5				
2. TYPE OF WORK DRILL NEW WELL <input checked="" type="checkbox"/> REENTER P&A WELL <input type="checkbox"/> DEEPEN WELL <input type="checkbox"/>						3. FIELD OR WILDCAT UNDESIGNATED				
4. TYPE OF WELL Gas Storage Well Coalbed Methane Well: NO						5. UNIT or COMMUNITIZATION AGREEMENT NAME				
6. NAME OF OPERATOR MAGNUM SOLUTION MINING, LLC						7. OPERATOR PHONE 801 993-7001				
8. ADDRESS OF OPERATOR 3165 E Millrock Dr, Holladay, UT, 84124						9. OPERATOR E-MAIL ddetton@westernenergyhub.com				
10. MINERAL LEASE NUMBER (FEDERAL, INDIAN, OR STATE) 51573-OBA			11. MINERAL OWNERSHIP FEDERAL <input type="checkbox"/> INDIAN <input type="checkbox"/> STATE <input checked="" type="checkbox"/> FEE <input type="checkbox"/>			12. SURFACE OWNERSHIP FEDERAL <input type="checkbox"/> INDIAN <input type="checkbox"/> STATE <input checked="" type="checkbox"/> FEE <input type="checkbox"/>				
13. NAME OF SURFACE OWNER (if box 12 = 'fee')						14. SURFACE OWNER PHONE (if box 12 = 'fee')				
15. ADDRESS OF SURFACE OWNER (if box 12 = 'fee')						16. SURFACE OWNER E-MAIL (if box 12 = 'fee')				
17. INDIAN ALLOTTEE OR TRIBE NAME (if box 12 = 'INDIAN')			18. INTEND TO COMMINGLE PRODUCTION FROM MULTIPLE FORMATIONS YES <input type="checkbox"/> (Submit Commingling Application) NO <input checked="" type="checkbox"/>			19. SLANT VERTICAL <input checked="" type="checkbox"/> DIRECTIONAL <input type="checkbox"/> HORIZONTAL <input type="checkbox"/>				
20. LOCATION OF WELL		FOOTAGES		QTR-QTR	SECTION	TOWNSHIP		RANGE	MERIDIAN	
LOCATION AT SURFACE		147 FSL 167 FWL		SWSW	23	15.0 S		7.0 W	S	
Top of Uppermost Producing Zone		147 FSL 167 FWL		SWSW	23	15.0 S		7.0 W	S	
At Total Depth		147 FSL 167 FWL		SWSW	23	15.0 S		7.0 W	S	
21. COUNTY MILLARD			22. DISTANCE TO NEAREST LEASE LINE (Feet) 220			23. NUMBER OF ACRES IN DRILLING UNIT 2				
			25. DISTANCE TO NEAREST WELL IN SAME POOL (Applied For Drilling or Completed) 1990			26. PROPOSED DEPTH MD: 4800 TVD: 4800				
27. ELEVATION - GROUND LEVEL 4614			28. BOND NUMBER B008001			29. SOURCE OF DRILLING WATER / WATER RIGHTS APPROVAL NUMBER IF APPLICABLE 68-396				
<b>Hole, Casing, and Cement Information</b>										
String	Hole Size	Casing Size	Length	Weight	Grade & Thread	Max Mud Wt.	Cement	Sacks	Yield	Weight
COND	36	36	0 - 150	282.4	B Casing	0.0	No Used	0	0.0	0.0
SURF	34	30	0 - 750	234.3	B Casing	9.5	Class A	887	1.18	15.6
I1	28	24	0 - 2500	245.6	X-52 Casing	10.2	Class A	2404	1.18	15.6
I2	24	20	0 - 1800	133.0	N-80 Buttress	10.2	Class G	1393	1.24	16.3
			1800 - 3350	191.0	X-56 Casing	10.2	Class G	1200	1.24	16.3
Prod	22	16	0 - 2000	95.0	N-80 Buttress	10.4	Class G	2006	1.24	16.3
			2000 - 3450	118.0	N-80 Buttress	10.4	Class G	1454	1.24	16.3
<b>ATTACHMENTS</b>										
<b>VERIFY THE FOLLOWING ARE ATTACHED IN ACCORDANCE WITH THE UTAH OIL AND GAS CONSERVATION GENERAL RULES</b>										
<input checked="" type="checkbox"/> WELL PLAT OR MAP PREPARED BY LICENSED SURVEYOR OR ENGINEER					<input checked="" type="checkbox"/> COMPLETE DRILLING PLAN					
<input checked="" type="checkbox"/> AFFIDAVIT OF STATUS OF SURFACE OWNER AGREEMENT (IF FEE SURFACE)					<input type="checkbox"/> FORM 5. IF OPERATOR IS OTHER THAN THE LEASE OWNER					
<input type="checkbox"/> DIRECTIONAL SURVEY PLAN (IF DIRECTIONALLY OR HORIZONTALLY DRILLED)					<input checked="" type="checkbox"/> TOPOGRAPHICAL MAP					
NAME Tiffany A. James			TITLE Director of GR and Env Svcs			PHONE 801 993-7001				
SIGNATURE			DATE 11/03/2011			EMAIL tjames@westernenergyhub.com				
API NUMBER ASSIGNED 43027500020000			APPROVAL  Permit Manager							

RECEIVED: May 02, 2013



# Application for Permit to Drill Magnum Cavern Well 5

Drilling Plan



# Application for Permit to Drill Magnum Cavern Well 5

## Drilling Plan

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10/31/2011

(revised 2/22/2012)

*Prepared by*

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## Table of Contents

<b>Section 1</b>	<b>Drilling/Well Construction Plan.....</b>	<b>1-1</b>
1.1	Plan Summary.....	1-1
1.2	16-Inch Drilling/Well Construction Plan.....	1-2
1.3	Welding Protocol .....	1-4
1.4	Specifications for Cementing Services and Materials .....	1-5
1.5	Well Conditioning.....	1-6
1.6	Reporting.....	1-7
<b>Section 2</b>	<b>Conceptual 16-Inch Injection Well Casing Program .....</b>	<b>2-1</b>
2.1	General Well Design.....	2-1
2.2	Casing Design Calculations .....	2-3
2.2.1	Conductor Pipe.....	2-3
2.2.2	Surface Casing .....	2-3
2.2.3	Intermediate Casing .....	2-4
2.2.4	First Salt String Casing .....	2-5
2.2.5	Production String Casing .....	2-6
2.2.6	Outer String of Mining Tubing .....	2-7
2.2.7	Inner String of Mining Tubing.....	2-8
2.3	Sources .....	2-9
<b>Section 3</b>	<b>Mechanical Integrity Testing.....</b>	<b>3-1</b>
3.1	During Drilling .....	3-1
3.2	Test of the 16-Inch Casing and the Cavern during Development.....	3-1
3.3	Storage Operations.....	3-2
<b>Section 4</b>	<b>Operating Plan and Procedures .....</b>	<b>4-1</b>
4.1	16-Inch Injection Well Operating Plan and Procedures .....	4-1
<b>Section 5</b>	<b>Plugging and Abandonment Plan.....</b>	<b>5-1</b>
5.1	16-Inch Injection Well Plugging and Abandonment Plan .....	5-1

## Tables

Table 1-1	16-Inch Injection Well Proposed Casing and Cementing Program .....	1-7
Table 2-1	Summary of Casings for Magnum Gas Storage Well.....	2-2
Table 2-2	Summary of Calculated Factors of Safety .....	2-2

## Appendices

Appendix A	Exhibits .....	A-1
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## Section 1

# Drilling/Well Construction Plan

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## 1.1 Plan Summary

This Application for Permit to Drill has incorporated all of the sections in the DOGM APD Checklist. Additional requirements for the drilling program are listed on the Instructions page of the Application. The discussion below is intended to respond directly to the drilling program additional requirements.

*1. The estimated tops of important geologic markers:*

Important geologic markers are shown in **Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design**. General geologic markers include clay-confining layers that generally delineate the shallow unconfined aquifer, the shallow artesian aquifer, the deep artesian aquifer, and the basement artesian aquifer. The main marker identified on site is the transition between the alluvial aquifers and the salt structure which begins at approximately 3,250 feet.

*2. The estimated depths at which the top and the bottom of anticipated water, oil, gas, or other mineral-bearing formations are expected to be encountered, and the owners or operator's plans for protecting such resources:*

The shallow water table has been found on site to be at an approximate depth of 60 feet. Water continues to be encountered until entering the salt structure, which in and of itself is unsaturated. Significant decreases in water quality occur within the salt transition zone starting at about 3,000 feet.

Protection of the ground water resource will be ensured through the casing and cementing program proposed to be implemented as provided on **Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design**, the Casing Design report, and the Well Drilling/Construction Plan.

No oil or gas has been found on site, nor is it expected.

*3. The owner's or operator's minimum specifications for pressure control equipment to be used and a schematic diagram thereof showing sizes, pressure ratings or API series, proposed testing procedures and testing frequency:*

See the **Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design**, the "16-Inch Drilling/Well Construction Plan" and the "Conceptual 16-Inch Well Casing Program" for the descriptions of the drilling equipment and casing program.

*4. Any supplementary information more completely describing the drilling equipment and casing program as shown on this form:*

See the "16-Inch Drilling/Well Construction Plan" and the "Conceptual 16-Inch Well Casing Program" for the descriptions of the drilling equipment and casing program.

*5. The type and characteristics of the proposed circulating medium or mediums to be employed in drilling, the quantities and types of mud and weighting material to be maintained, and the monitoring equipment to be used on the mud system:*

The Fluids Program will be completed by the drilling contractor's mud engineer prior to well drilling. The Reserve Pit will be lined with a 20-mil HDPE liner. See **Exhibit B: Magnum Cavern Well 5 Well Pad** and **Exhibit C: Magnum Cavern Well 5 Well Pad Cross Sections** for details of the Reserve Pit.

*6. The anticipated type and amount of testing, logging, and coring:*

See the "16-Inch Drilling/Well Construction Plan."

*7. The expected bottom hole pressure and any anticipated abnormal pressures or temperatures or potential hazards, such as hydrogen sulfide, expected to be encountered, along with contingency plans for mitigating such identified hazards:*

See the "Operating Plan and Procedures" for the operating pressures. No abnormal pressures, temperatures, or potential hazards were encountered in the drilling of exploratory well MH-1, nor are they anticipated on future wells.

*8. Any other facets of the proposed operation which the lessee or operator desires to point out for the division's consideration of the application:*

None.

## **1.2 16-Inch Drilling/Well Construction Plan**

The following is the general program to be used to drill the Magnum 16-inch injection wells. Depths shown are approximate, **from Ground Level**.

1. Rig up drilling rig.
2. Drive 36-inch conductor casing to approximately 150 feet or refusal.
3. Drill a 17-1/2-inch hole to  $\pm 780$  feet and log.
4. Open 17-1/2-inch hole up to 34-inch with hole openers of increasing size.
5. Run and cement 750 feet of 30-inch O.D., 0.75-inch wall thickness, API 5L Grade B pipe. Centralizers to be placed every other casing section.
6. Allow the cement to set a minimum of 18 hours. Pressure test the casing in accordance with State rules.
7. After the cement sets, cut off the 30-inch casing and weld on a 30-inch x 20-inch reducer and 21-1/4-inch flange. Nipple-up a 20-inch annular BOP.
8. Drill a 17-1/2-inch hole to slightly above top of salt structure estimated to be  $\pm 2,550$  feet. Lost circulation may occur over this interval; control as necessary by the use of lost circulation material, cement plugs or drill without returns.

9. Run gamma ray, SP induction and resistivity logs as specified.
10. Open the 17-1/2-inch hole to 28-inch with hole openers of increasing size.
11. Run X-Y caliper log.
12. Run and cement  $\pm$  2,500 feet of 24-inch O.D. 1-inch wall thickness, API X-52 T&C casing. Use the stab-in cementing method. Centralizers to be placed every other casing section.
13. After the cement sets, pressure test the casing in accordance with State rules.
14. Cut off the 24-inch casing and weld on a 24-inch x 20-inch reducer and 21-1/4-inch flange. Nipple up a 20-inch annular BOP.
15. Switch to salt saturated mud after 24-inch casing is set and when drilling encounters the top of the salt structure.
16. Drill a 17-1/2-inch hole to  $\pm$  3,400 feet.
17. Run gamma ray, SP induction, neutron and bulk density logs as specified.
18. Open the 17-1/2-inch hole to 24-inch with hole openers and under reamers of increasing size.
19. Run X-Y caliper log.
20. Run and cement 1,800 feet of 20-inch O.D., 0.635-inch wall thickness, API N-80 BT&C and 1,550 feet of 20-inch O.D. and 0.938-inch wall thickness, X-56, T&C threaded and coupled line pipe. Use the stab-in cementing method. Centralizers to be placed every other casing section.
21. Allow the cement to set a minimum of 72 hours. Pressure test the casing in accordance with State rules.
22. Cut off the 20-inch casing and weld on a 21-1/4-inch flange. Nipple up a 20-inch annular BOP.
23. Drill a 17-1/2-inch hole to  $\pm$ 3,500 feet.
24. Run gamma ray, SP induction, neutron and bulk density logs as specified.
25. Open the 17-1/2-inch hole up to 22-inch using hole openers and under-reamers.
26. Run X-Y caliper log.
27. Run and cement 2,000 feet of 16-inch O.D. 0.566-inch and 1,450 feet of 16-inch O.D. 0.715-inch wall thickness, API N-80 BT&C casing. Use the stab-in cementing method. Centralizers to be placed every other casing section.
28. Allow the cement to set a minimum of 72 hours. Pressure test the casing in accordance with State rules.
29. Drill out plug and ten feet of salt formation.
30. Pressure test casing shoe in accordance with the State rules and regulations.
31. Drill a 12-1/4-inch hole to  $\pm$ 4,800 feet.

32. Log cuttings and check for loss of drilling fluid indicating a porous formation is encountered. If so, perform a tightness test over this interval.
33. Run gamma ray, neutron and bulk density logs as specified.
34. If logs indicate a porous zone in the salt section, perform tightness test over the zone.
35. Under ream the 12-1/4-inch hole to 17-1/2-inch down to a depth of 4,700 feet.
36. Run X-Y caliper log.
37. Run casing inspection and cement bond logs in 16-inch casing from shoe to surface.
38. Run in approx. 4,250 feet of 13-3/8-inch, 72 lb/ft N-80, BT&C Casing.
39. Install and test the upper wellhead assembly (see **Exhibit D: Magnum Cavern Well 5 Injection Wellhead Design**).
40. Run in approx. 4,700 feet of 8-5/8-inch, 36 lb/ft, K-55, BT&C Casing.
41. Install remainder of wellhead (see **Exhibit D: Magnum Cavern Well 5 Injection Wellhead Design**).
42. Rig down and move out rig from location.
43. Clean up location.

### 1.3 Welding Protocol

1. Lift ring welding and inspection to be performed in accordance with AWS (American Welding Society) D1.1 Structural Welding Code. Perform nondestructive testing (NDT) on the welds using ultrasonic shear wave equipment as specified in AWS D1.1 and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2006 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2006 Edition..
2. Casing double joint welding shall be performed in accordance with API Standard 1104 Welding of Pipelines and Related Facilities. Pipe base material's carbon equivalency will be computed from the material composition as written in the Material Test Report (MTR) that is provided when the pipe is purchased. The welding contractor will provide a Welding Procedure Specification (WPS) that matches the base material and Procedure Qualification Report (PQR) and welders who are qualified to the WPS with Welders Qualification Report (WQR). The welding contractor will provide the WQR for each potential welder prior to beginning production welding. The field supervisor will verify that the WQR and welder's photo identification match. Perform nondestructive testing (NDT) on the butt welds using radiography as specified in API Standard 1104 and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2006 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2006 Edition. Each completed girth, butt weld shall be radiograph tested to API Standard 1104 qualifications. The radiograph methods and qualifications shall comply with API Standard 1104 –"Certification of

Nondestructive Testing Personnel” and “Acceptance Methods for Nondestructive Testing Personnel”.

3. Casing rig welding shall be performed in accordance with API Standard 1104 Welding of Pipelines and Related Facilities. Pipe base material's carbon equivalency will be computed from the material composition as written in the Material Test Report (MTR) that is provided when the pipe is purchased. The welding contractor will provide a Welding Procedure Specification (WPS) that matches the base material and Procedure Qualification Report (PQR) and welders who are qualified to the WPS with Welders Qualification Report (WQR). The welding contractor will provide the WQR for each potential welder prior to beginning production welding. The field supervisor will verify that the WQR and welder's photo identification match. Perform nondestructive testing (NDT) on the butt welds using radiography as specified in API Standard 1104 and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2006 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2006 Edition. Each completed girth, butt weld shall be nondestructively tested to API Standard 1104 qualifications. The test methods and qualifications shall comply with API Standard 1104 “Certification of Nondestructive Testing Personnel” and “Acceptance Methods for Nondestructive Testing Personnel”.

#### 1.4 Specifications for Cementing Services and Materials

This specification covers the requirements to supply cement, equipment and services for storage wells located near Delta, UT. The work will be conducted from a land rig. Cement bond logs cannot be used with reliability on the 20-inch plus well casings proposed for the gas storage products wells and therefore will not be run on the larger casings. A review of cement bonding capabilities with PB Energy Storage Systems has confirmed that there are no test methods currently available to conduct a bond log. Therefore, cementing operations will be visually verified at the time of cementing via the observance of cement rising within the outer well annulus to the surface (see **Table 1-1**).

Proposed wellbore configuration (Depths RKB):

- 36-inch Conductor Pipe: 0 - Approx. 150 feet (Driven to refusal)
  - 30-inch Surface Casing: 0 - Approx. 750 feet (Approx. 34-inch Open Hole)
  - 24-inch Intermediate Casing: 0 – 2,500 feet (Approx. 28-inch Open Hole)
  - 20-inch Next to Last Casing: 0 – 3,350 feet (Approx. 24-inch Open Hole)
  - 16-inch Last Cemented Casing: 0 – 3,450 feet (Approx. 22-inch Open Hole)
  - Top of Salt: Approx. 3,250 feet
1. Cement specifications for the 30-inch Surface casing. Cement job will be pumped through a stabbed-in 5-inch DP.
    - a. Cement to surface: Class A (Standard) + Defoamer (if deemed necessary)

- b. Water Ratio 5.2 gals/sk
  - c. Slurry Weight 15.6 lbs/gal.
  - d. Slurry Volume 1.18 cu. ft./sack
  - e. Excess 50% Open Hole Volume (4 Arm Caliper Available)
2. Cement specifications for the 24-inch Intermediate. Cement job will be pumped through a stabbed-in 5-inch DP.
  - a. Cement to surface: Class A (Standard) + Defoamer (if deemed necessary).
  - b. Water Ratio 5.2 gals/sk
  - c. Slurry Weight 15.6 lbs/gal.
  - d. Slurry Volume 1.18 cu. ft./sack
  - e. Excess 50% Open Hole Volume (4 Arm Caliper Available)
3. Cement specifications for the 20-inch Next to Last Casing. Cement job will be pumped through a stabbed-in 5-inch DP.
  - a. Cement to surface: Class G (Premium) + 37.2% Salt + Defoamer (if deemed necessary).
  - b. Water Ratio 5.0 gals/sk
  - c. Slurry Weight 16.3 lbs/gal.
  - d. Slurry Volume 1.24 cu. ft./sack
  - e. Excess 30% Open Hole Volume (4 Arm Caliper Available)
4. Cement specifications for the 16-inch Last Casing. Cement job will be pumped through a stabbed-in 5-inch DP.
  - a. Cement to surface: Class G (Premium) + 37.2% Salt + Defoamer (if deemed necessary).
  - b. Water Ratio 5.0 gals/sk
  - c. Slurry Weight 16.3 lbs/gal.
  - d. Slurry Volume 1.24 cu. ft./sack
  - e. Excess 30% Open Hole Volume (4 Arm Caliper Available)

## 1.5 Well Conditioning

Before commencing drilling operations (spudding the well), Magnum will provide detailed procedures for conditioning the hole prior to cementing casing. The pre-flush procedure will ensure that the wellbore is properly conditioned for cementing operations in accordance with recommendations from the cementing contractor.

The well is conditioned to circulate the drilling fluids, sweep cuttings out of the hole, obtain consistent fluid properties, and adjust the fluid viscosity and density in an attempt to prevent cement channeling through the fluid. Detailed procedures for this process have not been written at this time as it is a typical task during drilling, but when the drilling fluids contractor is hired his mud engineer will be tasked to write a program for the fluids.



## 1.6 Reporting

During Drilling the casing cement jobs shall be documented by an affidavit from the cementing company showing the amount and type of cementing materials and the method of placement.

Three samples of the cement slurry for each of the intermediate and salt casings shall be collected in suitable sized and shaped containers so that the hardened cement can be tested for compressive strength.

**Table 1-1: 16-Inch Injection Well Proposed Casing and Cementing Program**

Hole Size	Driven	34-inch	28-inch	24-inch	24-inch	22-inch	22-inch
Casing Size	36-inch	30-inch	24-inch	20-inch	20-inch	16-inch	16-inch
<b>Mud Weight Type</b>	N/A	9.5 ppg Fresh Water	10.2 ppg Fresh Water	10.2 ppg Saturated Brine	10.2 ppg Saturated Brine	10.4 ppg Saturated Brine	10.4 ppg Saturated Brine
<b>Slurry Weight</b>	N/A	15.6 ppg Fresh Water	15.6 ppg Fresh Water	16.3 ppg Saturated Brine	16.3 ppg Saturated Brine	16.3 ppg Saturated Brine	16.3 ppg Saturated Brine
<b>Cement Type</b>	N/A	Class A Standard	Class A Standard	Class G Premium	Class G Premium	Class G Premium	Class G Premium
<b>Cement Yield</b>	N/A	887 sks	2,404 sks	1,393 sks	1,200 sks	2,006 sks	1,454 sks
<b>Cement Volume</b>	N/A	1.18cu ft/sk	1.18 cu ft/sk	1.24 cu ft/sk	1.24 cu ft/sk	1.24 cu ft/sk	1.24 cu ft/sk

## Section 2

# Conceptual 16-Inch Injection Well Casing Program

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### 2.1 General Well Design

The 16-inch injection wells for the Magnum salt storage caverns will be drilled from surface to more than a thousand feet into the salt. The wells will have a water protection string or surface casing and two casing strings (intermediate and production casings) cemented into the upper section of the salt. The casing string will be run in a wellbore of slightly larger diameter than the casing and cemented into place. The drilling and cementing programs are presented in Section 3.

The surface casing is sized to allow for a second contingent intermediate string in the event that a problem zone is encountered during drilling that requires a casing string to seal it off. The well in general is sized to allow product injection into and production from the completed cavern at 2,500 gpm with a velocity of less than 20 feet per second. The casing sizes also allow use of tubing strings for mining that will maintain fluid velocities at about 20 feet per second. This is an acceptable range for mining operations.

The various casing strings are sized to withstand foreseeable collapse, burst and tensile forces that might act upon the casing. The goal of the design was to specify casing sizes and grades that allow a safety factor of about 1.0 for collapse, 1.0 for burst and 1.6 for tensile forces based on published strength data.

In normal operations, collapse forces generally are greatest during cementing of the casing string when the inside of the casing is filled with drilling mud and the annulus is filled with heavier cement slurry. In normal operations, the collapse forces resulting from the weight difference between cement and drilling mud are low. At 4,000 feet this can amount to about 1,000 psi. However, in keeping with generally accepted practices (such as ERCB Directive 10) the collapse pressures are calculated with the assumption that the annulus is filled with cement and the inside of the casing is air-filled.

In the case of the outer mining tubing string, the collapse pressures result from the use of nitrogen as a blanket material. The nitrogen roof blanket pressures will be greatest at the start of mining when the nitrogen roof blanket is at its deepest location. At the worst case (for collapse calculations) the largest pressures occur during reverse mining when the cavern is shut-in. In this instance, water is in the outer tubing string, and the brine in the cavern is unsaturated and continues to dissolve salt. The continued dissolution increases space in the cavern so that the wellhead fluid pressures fall to a vacuum. If at the same time the borehole has closed around the hanging tubing, the nitrogen pressure will be locked in at its normal operating pressure. The full nitrogen pressure of about 2,000 psi will be acting against the 13-3/8-inch tubing with a vacuum on the inside. The tubing has been sized to withstand this type of worst-case event to mitigate the low potential for occurrence.

Burst forces again are generally greatest during cementing operations but are normally very low during normal operations. The worst case occurs if the casing has been run in the well, the float shoe/collar gets stuck shut and a gas blowout occurs at the bottom of the hole. In this event the full hydrostatic pressure of the drilling mud in the casing would be acting against a low-pressure gas-filled annulus. The pressure of the annulus was conservatively assumed to be "0" psi.

In the case of the final cemented casing, significant burst forces occur during mining operations due to the use of nitrogen as the blanket material. After mining is completed, lesser pressures will act inside the final cemented casing as a result of normal liquid storage operations.

The casing program designed for the Magnum 16-inch injection wells are summarized in **Table 2-1**. In the event that these casing and pipe sizes are not available, the next higher grade or increased wall thickness should be chosen. Calculations for forces acting on the various strings are shown in Appendix A. The safety factors for the various loading scenarios are summarized in **Table 2-2**.

**Table 2-1: Summary of Casings for Magnum Gas Storage Well**

Casing String	Size – inches	Weight – pounds/foot	Grade	Depth – feet
Conductor	36	282.35	B	0 – 150
Surface	30	234.29	B	0 – 750
Intermediate	24	245.64	X-52	0 – 2,500
First Salt	20	133	N-80	0 – 1,800
First Salt Final cemented depth 3,350 feet	20	190.96	X-56	1,800 – 3,350
Production (2 <sup>nd</sup> Salt)	16	95	N-80	0 – 2,000
Production (2 <sup>nd</sup> Salt) Final cemented depth 3,450 feet	16	118	N-80	2,000 – 3,450
Outer Mining String	13-3/8	72	N-80	0 – 4,250
Inner Mining String	8-5/8	36	K-55	0 – 4,700

**Table 2-2: Summary of Calculated Factors of Safety**

Casing String	Safety Factor		
	Collapse – 1.0	Burst – 1.0	Tensile – 1.6
36-inch Conductor	N/A	N/A	N/A
30-inch Surface	1.48	5.67	15.53
24-inch Intermediate	1.10	2.26	4.54
20-inch First Salt String	1.05	4.66	3.15
20-inch First Salt String	1.08	1.97	N/A
16-inch Production (2 <sup>nd</sup> Salt String)	1.29	4.58	3.67
16-inch Production (2 <sup>nd</sup> Salt String)	1.26	3.36	N/A
13-3/8-inch Outer Mining String	1.33	1.67	5.53
8-5/8-inch Inner Mining String	N/A	N/A	4.08

## 2.2 Casing Design Calculations

### 2.2.1 Conductor Pipe

36-inch, Wall thickness 1-inch, A-53 Grade B, Plain end, welded pipe from 0 feet to approximately 150 feet. Pipe is to be driven by pile driver to refusal.

### 2.2.2 Surface Casing

30-inch, 234.29 lb/ft, Wall Thickness 0.75-inch, Grade B, Plain end, welded, pipe from 0 feet to 750 feet.

#### 2.2.2.1 Collapse Calculations

Assume that the bottom hole depth of the 30-inch surface casing is at  $\pm 750$  feet from surface, with a welded float shoe located at the bottom of the casing string. The worst-case scenario for collapse pressure would be a full column of cement in the casing/hole annulus, and a column of gas inside the 30-inch surface casing.

- (750 feet) (0.052 psi/ft) (15.6 lb/gal cement) = 608 psi hydrostatic pressure exerted on the exterior of the 30-inch casing, at 750 feet.
- 0 psi hydrostatic pressure exerted on the interior of the 30-inch casing, at 750 feet.
- Differential pressure, (collapse pressure) annulus pressure verses pressure inside the 30-inch casing equals:  $608 \text{ psi} - 0 \text{ psi} = 608 \text{ psi}$ .

The 30-inch surface casing has a collapse rating of 898 psi. According to the above differential calculations, the proposed 30-inch surface casing to be used has a collapse rating greater than any outside pressure that will be exerted against the exterior of the casing.

#### 2.2.2.2 Burst Calculations

Assume that the bottom hole depth of the 30-inch surface casing is at  $\pm 750$  feet from surface, with a welded float shoe located at the bottom of the casing string. The 30-inch surface casing will be loaded with 9.5 lb per gallon drilling mud. The worst case for burst is if the float shoe becomes stuck closed and a gas blowout occurs at the shoe. In this case there would be a column of gas outside of the casing and a full column of drilling mud inside the casing.

- (750 feet) (0.052 psi/ft/lb/gal) (9.5 lb/gal drilling mud) = 371 psi hydrostatic pressure exerted on the interior of the 30-inch casing, at 750 feet.
- Differential pressure, (burst pressure) inside pressure verses annulus pressure on the outside of the 30-inch casing equals  $371 \text{ psi} - 0 \text{ psi} = 371 \text{ psi}$ .

According to API Bulletin 5L, the 30-inch surface casing has a minimum test pressure of 2,100 psi. According to the above differential calculations, the proposed 30-inch surface casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.

#### 2.2.2.3 Tensile Calculations

The proposed 30-inch surface casing weighs 234.29 lb/ft and will be set at approximately 750 feet, for a total string weight of 175,717.5 lbs. The 30-inch, welded surface casing proposed

has a tensile rating of 2,730,000 lbs, which is greater than tensile weight exerted by the weight of the casing.

### **2.2.3 Intermediate String Casing**

24-inch, 245.64 lb/ft, Wall Thickness 1.0-inch, X-52 Grade, Plain end fitted with threaded connections from 0 feet to 2,500 feet.

#### **2.2.3.1 Collapse Calculations**

Assume that the bottom hole depth of the 24-inch 245.64 lb/ft casing (pipe) at  $\pm 2,500$  feet from surface, with a welded float shoe located at the bottom of the casing string. The worst-case scenario for collapse pressure would be a full column of cement in the casing/hole annulus, and an empty column inside the 24-inch surface casing.

- (2,500 feet) (0.052 psi/ft/lb/gal) (15.6 lb/gal cement) = 2,028 psi hydrostatic pressure exerted on the exterior of the 24-inch casing, at 2,500 feet.
- Differential pressure, (collapse pressure) annulus pressure versus pressure inside the 24-inch casing at 2,500 feet equals: 2,028 psi – 0 psi = 2,028 psi.

According to API Bulletin 5L, the 24-inch outer string casing at 2,500 feet has a collapse rating of 2,230 psi and at 3,200 feet a collapse rating of 3,130 psi. According to the above differential calculations, the proposed 24-inch outer string casing to be used has a collapse rating equal to or greater than any outside pressure that will be exerted against the exterior of the casing.

#### **2.2.3.2 Burst Calculations**

Assume that the bottom hole depth of the 24-inch surface casing is at  $\pm 2,500$  feet from surface, with a welded float shoe located at the bottom of the casing string. The 24-inch surface casing will be loaded with 10.2 lb per gallon drilling mud. The actual cement process will be down drill pipe, which will be stung into the float shoe at 2,500 feet so that the casing is not filled with cement. The worst case for burst is if the float shoe becomes stuck closed and a gas blowout occurs at the shoe. In this case there would be a column of gas outside the outside of the casing and a full column of drilling mud inside the casing.

- (2,500 feet) (0.052 psi/ft/lb/gal) (10.2 lb/gal drilling mud) = 1,326 psi hydrostatic pressure exerted on the interior of the 24-inch casing, at 2,500 feet.
- Differential pressure, (burst pressure) inside pressure versus annulus pressure on the outside of the 24-inch casing at 2,500 feet equals: 1,326 psi – 0 psi = 1,326 psi.

According to API Bulletin 5L, the 1-inch 24-inch outer string casing has a minimum test pressure of 3,000 psi. According to the above differential calculations, the proposed 24-inch surface casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.

#### **2.2.3.3 Tensile Calculations**

The proposed 24-inch outer string casing weighs 245.64 lb/ft at 2,500 feet for a total string weight of 614,100 lbs. The proposed 24-inch, threaded intermediate casing has a tensile rating of 3,757,000 lbs, which is greater than the tensile weight exerted by the weight of the casing.

### **2.2.4 First Salt String Casing**

20-Inch, 133 lb/ft, Wall Thickness 0.635-inch, N-80 Grade, Buttress connection, Casing from 0 to 1,800 feet. 20-Inch, 190.96 lb/ft, Wall Thickness 0.938-inch, X-56 Grade, Threaded pipe, from 1,800 to 3,350 feet.

#### **2.2.4.1 Collapse Calculations**

Assume that the bottom hole depth of the 20-inch first salt string of casing is at  $\pm 3,350$  feet from surface, with a welded float shoe located at the bottom of the casing string. The casing string will be made up of two weights of casing.

Above 1,800 feet the casing will be 133 lb/ft N-80 casing. From 1,800 feet to 3,350 feet the casing will be 190.96 lb/ft X-56 line pipe. This string will have buttress connections above 1,800 feet and proprietary connections on the line pipe. The worst-case scenario for collapse pressure would be a full column of cement in the casing/hole annulus, and an empty inside the 20-inch surface casing.

- (1,800 feet)  $(0.052 \text{ psi/ft/lb/gal}) (16.3 \text{ lb/gal cement}) = 1,526 \text{ psi}$  hydrostatic pressure exerted on the exterior of the 20-inch casing, at 1,800 feet.
  - (3,350 feet)  $(0.052 \text{ psi/ft/lb/gal}) (16.3 \text{ lb/gal cement}) = 2,839 \text{ psi}$  hydrostatic pressure exerted on the exterior of the 20-inch casing, at 3,350 feet.
- At 1,800 feet, the differential pressure equals:  $1,526 \text{ psi} - 0 \text{ psi} = 1,526 \text{ psi}$ . According to Lone Star Steel, the 20-inch 133-lb/ft casing has a collapse rating of 1,600 psi. According to the above differential calculations, the proposed 20-inch first salt string casing to be used has a collapse rating greater than any outside pressure that will be exerted against the exterior of the casing.
  - At 3,350 feet, the differential pressure equals:  $2,839 \text{ psi} - 0 \text{ psi} = 2,839 \text{ psi}$ . The 20-inch 190.96 lb/ft pipe has a collapse rating of 3,080 psi. According to the above differential calculations, the proposed 20-inch first salt string casing to be used has a collapse rating greater than any outside pressure that will be exerted against the exterior of the casing.

#### **2.2.4.2 Burst Calculations**

Assume that the bottom hole depth of the 20-inch surface casing is at  $\pm 3,350$  feet from surface, with a welded float shoe located at the bottom of the casing string. The 20-inch surface casing will be loaded with 10.2 lb per gallon drilling mud. The actual cement process will be down drill pipe, which will be stung into the float shoe at 3,350 feet so the casing will not be filled with cement. The worst case for burst considerations would be if there was a gas blowout in the salt after the casing was set but before it was cemented. This could potentially leave a column of gas along the outside of the casing and a full column of drilling mud inside the casing.

- (1,800 feet)  $(0.052 \text{ psi/ft/lb/gal}) (10.2 \text{ lb/gal drilling mud}) = 955 \text{ psi}$  hydrostatic pressure exerted on the interior of the 20-inch casing, at 1800 feet.
  - (3,350 feet)  $(0.052 \text{ psi/ft/lb/gal}) (10.2 \text{ lb/gal drilling mud}) = 1,777 \text{ psi}$  hydrostatic pressure exerted on the interior of the 20-inch casing, at 3,350 feet.



- Differential pressure (burst pressure), inside pressure verses annulus pressure on the outside of the 20-inch casing equals:  $955 \text{ psi} - 0 \text{ psi} = 955 \text{ psi}$ .
- Differential pressure (burst pressure), inside pressure verses annulus pressure on the outside of the 20-inch casing equals:  $1,777 \text{ psi} - 0 \text{ psi} = 1,777 \text{ psi}$ .

The 20-inch pipe has a minimum test pressure of 4,450 psi above 1,800 feet and 3,500 psi for the lower segment. According to the above differential calculations, the proposed 20-inch casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.

#### 2.2.4.3 *Tensile Calculations*

The 20-inch surface casing proposed weighs 133 lb/ft set at 1,800 feet and 190.96 lb/ft set at approximately 3,350 feet, for a total string weight of 535,388 lbs. API TR5C3 provides a tensile strength for the N-80 buttress end casing at the top of the string of 1,685,000 pounds; which exceeds the above-calculated weight of the 20-inch casing.

#### 2.2.5 Production String Casing

16-Inch, 95 lb/ft, N-80, wall thickness 0.566-inch, buttress connection, casing from 0 to 2,000 feet. 16-Inch, 118 lb/ft, N-80, wall thickness 0.715-inch, buttress connection, casing from 2,000 to 3,450 feet.

##### 2.2.5.1 *Collapse Calculations*

Assume that the bottom hole depth of the 16-inch production string of casing is at  $\pm 3,450$  feet from surface, with a welded float shoe located at the bottom of the casing string. This string will have buttress connections. The worst-case scenario for collapse pressure would be a full column of cement in the casing/hole annulus, and gas (from a blowout) inside the 16-inch surface casing.

- (2,000 feet) (0.052 psi/ft/lb/gal) (16.3 lb/gal cement) = 1,695 psi hydrostatic pressure exerted on the exterior of the 16-inch casing, at 2,000 feet.
  - (3,450 feet) (0.052 psi/ft/lb/gal) (16.3 lb/gal cement) = 2,924 psi hydrostatic pressure exerted on the exterior of the 16-inch casing, at 3,450 feet.
- Differential pressure, collapse pressure), annulus pressure verses pressure inside the 16-inch casing equals:  $1,695 \text{ psi} - 0 \text{ psi} = 1,695 \text{ psi}$ . According to Lone Star Steel, the 16-inch N-80 95 lb/ft casing has a collapse rating of 2,180 psi.
  - Differential pressure, collapse pressure), annulus pressure verses pressure inside the 16-inch casing equals:  $2,924 \text{ psi} - 0 \text{ psi} = 2,924 \text{ psi}$ . According to Lonestar, the 16-inch N-80, 118-lb/ft casing has a collapse rating of 3,680 psi.

According to the above differential calculations, the proposed 16-inch casing to be used has a collapse rating greater than any outside pressure that will be exerted against the exterior of the casing.

##### 2.2.5.2 *Burst Calculations*

Assume that the bottom hole depth of the 16-inch surface casing is at  $\pm 3,450$  feet from surface, with a welded float shoe located at the bottom of the casing string. The 16-inch surface casing

will be loaded with 10.2 lb per gallon drilling mud. The actual cement process will be down drill pipe, which will be stung into the float shoe at 3,450 feet so the inside of the casing will not be filled with cement. The worst case for burst considerations would be if there was a gas blowout in the salt after the casing was set but before it was cemented. This could potentially leave a column of gas along the outside of the casing.

- (2,000 feet) (0.052 psi/ft/lb/gal) (10.4 lb/gal drilling mud) = 1,082 psi hydrostatic pressure exerted on the interior of the 16-inch casing, at 2,000 feet.
  - (3,450 feet) (0.052 psi/ft/lb/gal) (10.4 lb/gal drilling mud) = 1,866 psi hydrostatic pressure exerted on the interior of the 16-inch casing, at 3,450 feet.
- Differential pressure (burst pressure), inside pressure verses annulus pressure on the outside of the 16-inch casing equals: 1,082 psi – 0 psi = 1,082 psi. The 16-inch casing above 2,000 feet has a minimum test pressure of 4,950 psi. According to the above differential calculations, the proposed 16-inch surface casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.
  - Differential pressure (burst pressure), inside pressure verses annulus pressure on the outside of the 16-inch casing equals: 1,866 psi – 0 psi = 1,866 psi. According to Lone Star Steel, the 16-inch casing has a minimum test pressure of 6,260 psi. According to the above differential calculations, the proposed 16-inch surface casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.
- During mining operations, the 16-inch casing annulus will be filled with nitrogen used as a blanket during mining operations. At the surface, the maximum gas pressure will be about 2,028 psi /  $(e^{(0.00003347 * 0.58 * \text{depth})}) = 1,900$  psi. The wellhead gas pressure is below the rated burst pressure of 4,950 psi of the 16-inch casing at the surface.

### 2.2.5.3 ***Tensile Calculations***

The 16-inch surface casing will be set at approximately 3,450 feet, for a total string weight of 361,100 lbs. Lone Star Steel provides a tensile strength for buttress end casing of 1,326,000 pounds; which greatly exceeds the above-calculated weight of the 16-inch casing.

### 2.2.6 **Outer String of Mining Tubing**

13-3/8-inch, 72 lb/ft, wall thickness 0.514-inch, N-80 grade, buttress connection, casing from 0 to 4,250 feet.

#### 2.2.6.1 ***Collapse Calculations***

Assume that the nitrogen roof blanket will be at a depth of  $\pm 3,900$  feet from surface, the maximum differential pressure exerted against the 13-3/8-inch casing will be at the surface.

The worst-case scenario for collapse pressure would be a column of freshwater in the casing (during the first steps of mining) that goes on a vacuum when the well is shut-in and the brine in the cavern continues to dissolve salt; and nitrogen is in the annulus.

- (3,900 feet) (0.052 psi/ft/lb/gal) (10.0 lb/gal brine) = 2,028 psi hydrostatic pressure exerted on the exterior of the 13-3/8-inch casing, at 3,900 feet. The nitrogen pressure on the outside of the string and the brine pressure in the cavern are balanced at this point.
  - Pressure outside the 13-3/8-inch at the surface is (nitrogen blanket pressure) / (1.000316 ^ blanket level depth) = 2,028 / (1.000316 ^ 3,900) = 1,902 psi.
- (3,900 feet) (0.052 psi/ft/lb/gal) (10.0 lb/gal brine) = 2,028 psi hydrostatic pressure exerted on the interior of the 13-3/8-inch casing, at 3,900 feet.
- Differential pressure, collapse pressure), annulus pressure verses pressure inside the 13-3/8-inch casing at the surface equals: 1,902 psi – (-100 psi) (vacuum) = 2,002 psi. According to API Bulletin 5C2, the 13-3/8-inch string casing has a collapse rating of 2,670 psi. According to the above differential calculations, the proposed 13-3/8-inch casing to be used has a collapse rating greater than the pressure that will be exerted against the exterior of the casing.

#### 2.2.6.2 **Burst Calculations**

Assume that the bottom hole depth of the 13-3/8-inch surface casing is at ±4,250 feet from surface, with an open end of the casing string. The 13-3/8-inch surface casing will be loaded with 10.0 lb per gallon brine during reverse mining steps. The worst case for burst considerations would be if the nitrogen blanket bled off and the bottom of the 13-3/8-inch tubing was salted into the 16-inch production casing during normal operations. This could potentially leave a column of low-pressure gas along the outside of the tubing and high-pressure brine on the inside of the tubing string.

- Zero psi hydrostatic pressure exerted on the exterior of the 13-3/8-inch casing, at the 16-inch casing shoe.
- Pump pressure (Value unknown but assumed) 1,200 psi exerted on the 13-3/8-inch casing.
- Fluid pressure at 3,900 feet of (3,900 feet) (0.052 psi/ft/lb/gal) (10.0 lb/gal brine) = 2,028 psi exerted on the interior of the 13-3/8-inch casing at 3,900 feet.
- Differential pressure (burst pressure), inside pressure verses annulus pressure on the outside of the 13-3/8-inch casing equals: 2,028 psi + 1,200 psi (assumed pump pressure) – 0 psi = 3,228 psi. According to API Bulletin 5C2, the 13-3/8-inch casing has a minimum test pressure of 5,380 psi. According to the above differential calculations, the proposed 13-3/8-inch surface casing to be used has a minimum test pressure greater than any inside pressure that will be exerted against the interior of the casing.

#### 2.2.6.3 **Tensile Strength**

At this time, the depth for the outer string tubing is 72 lb/ft casing to 4,250 feet. Based on these depths, the maximum string weight will be 306,000 lbs. This is well below the maximum tensile strength at the surface of 1,693,000 lbs.

#### 2.2.7 **Inner String of Mining Tubing**

8-5/8-inch, 36 lb/ft, wall thickness 0.4-inch, K-55 Grade, buttress connection, casing from 0 to 4,700 feet.

### 2.2.7.1 ***Burst and Collapse Calculations***

The 8-5/8-inch inner wash string has the similar circumstance as the 13-3/8-inch outer string tubing, in that the tubing will have equal weight of fluids (brine water) on the outside as well as the inside, internal and external pressures will be equal. Therefore, since there will not be any differential pressures exerted externally or internally, burst and collapse calculations are not necessary. The 8-5/8-inch tubing will not have nitrogen acting against it.

### 2.2.7.2 ***Tensile Strength***

At this time, the deepest depth for the inner tubing (8-5/8-inch 36 lb/ft) is estimated at approximately 4,700 feet. Based on this depth, the maximum string weight will be 169,200 lbs. This is well below the maximum tensile 690,000 lbs.

## 2.3 **Sources**

OCTG Products, 23rd Edition, Lone Star Steel

American Petroleum Institute, Specification for Line Pipe, API Specification 5L

American Petroleum Institute, Bulletin on Performance Properties of Casing, Tubing and Drill Pipe, API Specification 5C2

American Petroleum Institute, Technical Report on Equations and Calculations for Casing, Tubing and Line Pipe Used as Casing or Tubing; and Performance Properties Tables for Casing and Tubing, API Technical Report 5C3

Energy Resource Conservation Board, 2008. Minimum Casing Design Requirements, Directive 010

## Section 3

# Mechanical Integrity Testing

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Several testing methods will be employed to demonstrate mechanical integrity of the well/cavern system. These methods vary depending upon the stage of development of the well or cavern.

### 3.1 During Drilling

After cementing the 16-inch production casing, the casing will be tested before continuing drilling. A hydraulic pressure test of the 16-inch production casing will be conducted before drilling out the plug (shoe) and after waiting at least 72 hours to allow the cement to set. The test pressure shall be 125% of the anticipated working pressure during product storage, about 2,020 psi at the cement plug or about 405 psi at the surface. The test will last 30 minutes. The test will be considered good if the pressure loss is less than 5%.

After drilling out the cement plug and drilling about 10 feet of salt below the casing shoe, a hydraulic pressure test of casing seat and cement in 16-inch production casing will be run. The surface test pressure will be 80% of the lithostatic pressure as calculated at the casing seat minus the hydrostatic pressure of the test fluid, or about 870 psi. The test will last 60 minutes. The test will be considered good if the pressure loss is less than 5%.

### 3.2 Test of the 16-Inch Casing and the Cavern during Development

Prior to initiating solution mining and again at the completion of solution mining, the cavern will be tested using the nitrogen mechanical integrity technique. The test pressure at the shoe of the 16-inch cemented casing will be about 0.75 psi per foot of depth, or about 0.23 psi per foot greater than the normal operating pressure (0.52 psi per foot of depth) to ensure that the casing and cement are not leaking.

The nitrogen mechanical integrity test technique essentially involves pressuring the well, and cavern after mining, to the desired test pressure, and injecting nitrogen in the outer annulus of the well (the space between the cemented 16-inch casing and the hanging 13-3/8-inch tubing) to a depth about 50 to 100 feet below the casing shoe.

The well will then be shut-in for 24 to 48 hours to allow the nitrogen temperature to equalize with the in-situ temperature. The initial depth of the nitrogen/brine interface below the casing shoe and the temperature of the wellbore will then be measured with a wireline tool. After a period of time, not less than 24 hours, determined by the size of the borehole below the casing shoe, a second interface and temperature survey will be run. The pressure at the wellhead will be monitored and recorded continuously during testing.

The change in the calculated volume of the nitrogen between the two interface measurements will be determined from the surface nitrogen pressure, the well temperature logs and the change in the

level of the nitrogen/brine interface. The change in the nitrogen volume will then be converted to an equivalent fluid loss.

The temperature stabilization period, the duration of the test and the desired depth of the initial nitrogen/brine interface level will be determined from logs run during and after well construction. The selection of these features will be made so as to ensure that the test has a minimum detectable leak rate (test sensitivity) of no more than 500 barrels per year of nitrogen. An acceptable test will be a demonstration that the calculated leak rate is less than the minimum detectable leak rate.

All pressure monitoring instruments will be calibrated in accordance with manufacturer's recommendations. Testing will be performed under the supervision of a degreed engineer experienced in salt cavern testing. The report will be submitted to the Executive Secretary within 60 days of completion of the test.

### **3.3 Storage Operations**

Following the post-completion mechanical integrity test, the caverns will be tested on a periodic basis using methods and procedures in accordance with requirements set forth by the State of Utah.

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## Section 4

# Operating Plan and Procedures

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## 4.1 16-Inch Injection Well Operating Plan and Procedures

The injection well operating plan and procedures is outlined within the report “Conceptual Solution Mining Plans for Development of 16-Inch Injection Wells at Delta, Utah”. A Cavern Well Schematic is also shown in **Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design**. The report generally defines the following operating criteria:

- Average Daily Rate: 2,500 gpm
- Maximum Daily Rate: 2,500 gpm
- Volume of Fluid to be Injected during Solution Mining (1 MMbbl cavern): 12 MMbbls of brine (504 million gallons), (see DWQ UIC Modification, October 21, 2011, Permit UTU-27-AP-9232389)
- Average Injection Pressure: 700 psi
- Maximum Injection Pressure: 700 psi

**Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design** and the “16-Inch Well Construction Plan” also includes information related to the mining methods and stages, tubing placements, testing, and information related to potential problems that could be associated with cavern creation.

Injected water will be obtained from local ground water sources within confined aquifers located generally at depths greater than 1,450 feet. Representative water quality data collected from exploratory well MH-1 within potential source zones was previously provided in the DWQ Underground Injection Control Permit application. Because the source of water is a new source, no quality range data is available for the source. However, little variation is expected due to the limiting nature of the confined aquifer.

## Section 5

# Plugging and Abandonment Plan

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## 5.1 16-Inch Injection Well Plugging and Abandonment Plan

The following procedures are provided as a general guideline. Actual plugging measures will be submitted in advance to DWQ (prior to commencement of product storage) or DOGM (after commencement of storage operations) for approval.

1. Form DOGM-9 will be submitted (after commencement of product storage) for procedural approval.
2. All stored product will be removed and the cavern will be filled with saturated brine water.
3. All free hanging tubing will be pulled from the well.
4. The exact depth to the bottom of the cemented production casing will be determined.
5. A drillable plug capable of supporting a cement plug will be installed in the cemented casing with the bottom of the plug within 10 feet of the end of the casing.
6. The following plugs will be placed. All cement plugs will be Class G cement with no additives and the slurry weight will be 14.5 pounds per gallon or more.
  - a. Bottom plug: A 300-foot plug from the plug at the bottom of the production casing upward.
  - b. Surface casing plug: A 150-foot plug from 75 feet below the bottom of the surface casing upward.
  - c. Top plug: A 75-foot plug from 75 feet below surface grade upward to surface.
7. The casing between each of the plugs shall be filled with a non-corrosive mud slurry of at least 10 pounds per gallon weight.
8. An alternative technique that could be used involves filling the entire wellbore with cement.

Upon completion of the plugging operation, all reports will be filed in accordance with DWQ or DOGM rules as applicable.

Appendix A

# Exhibits

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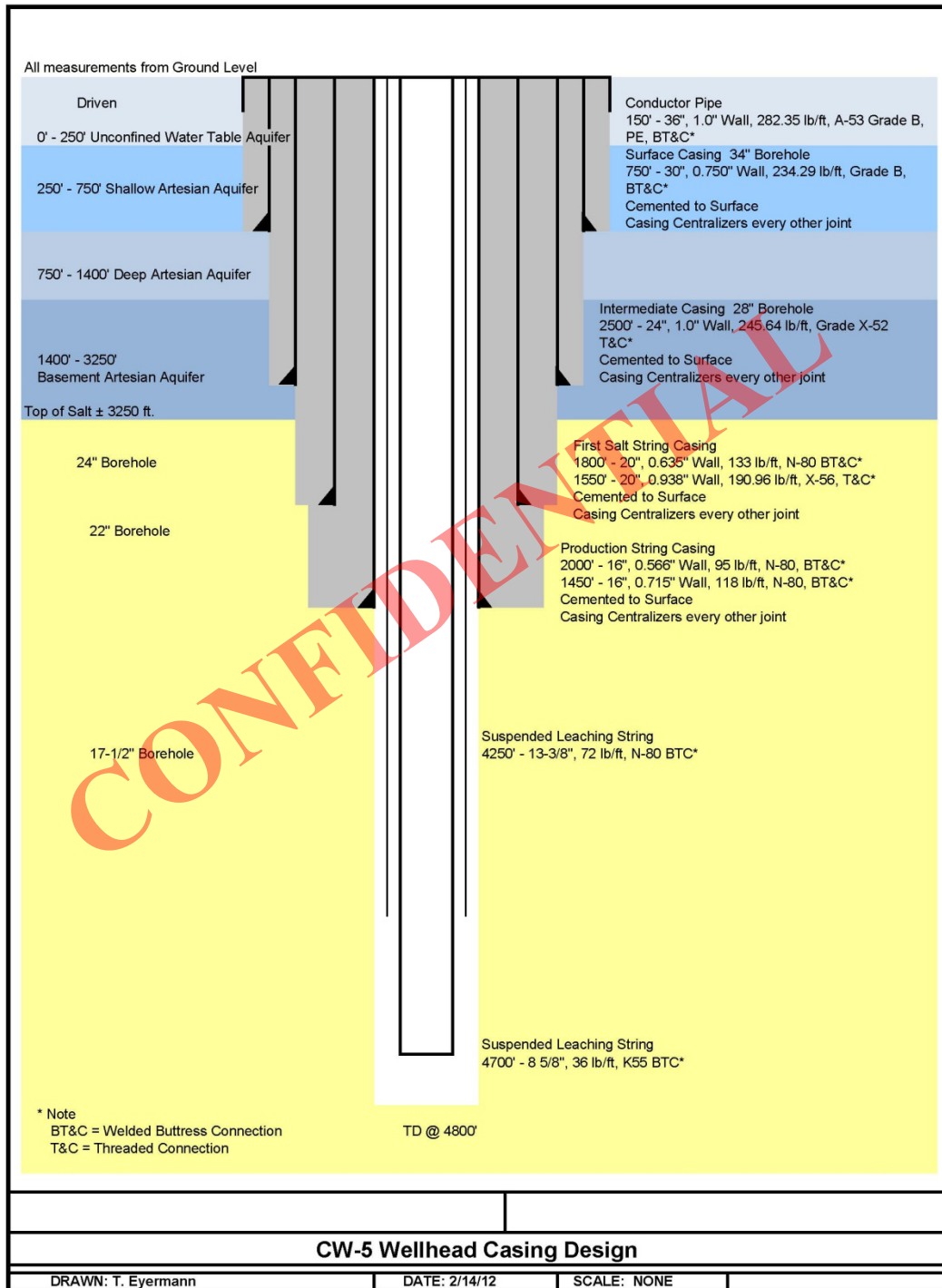


Exhibit A: Magnum Cavern Well 5 Wellhead Casing Design



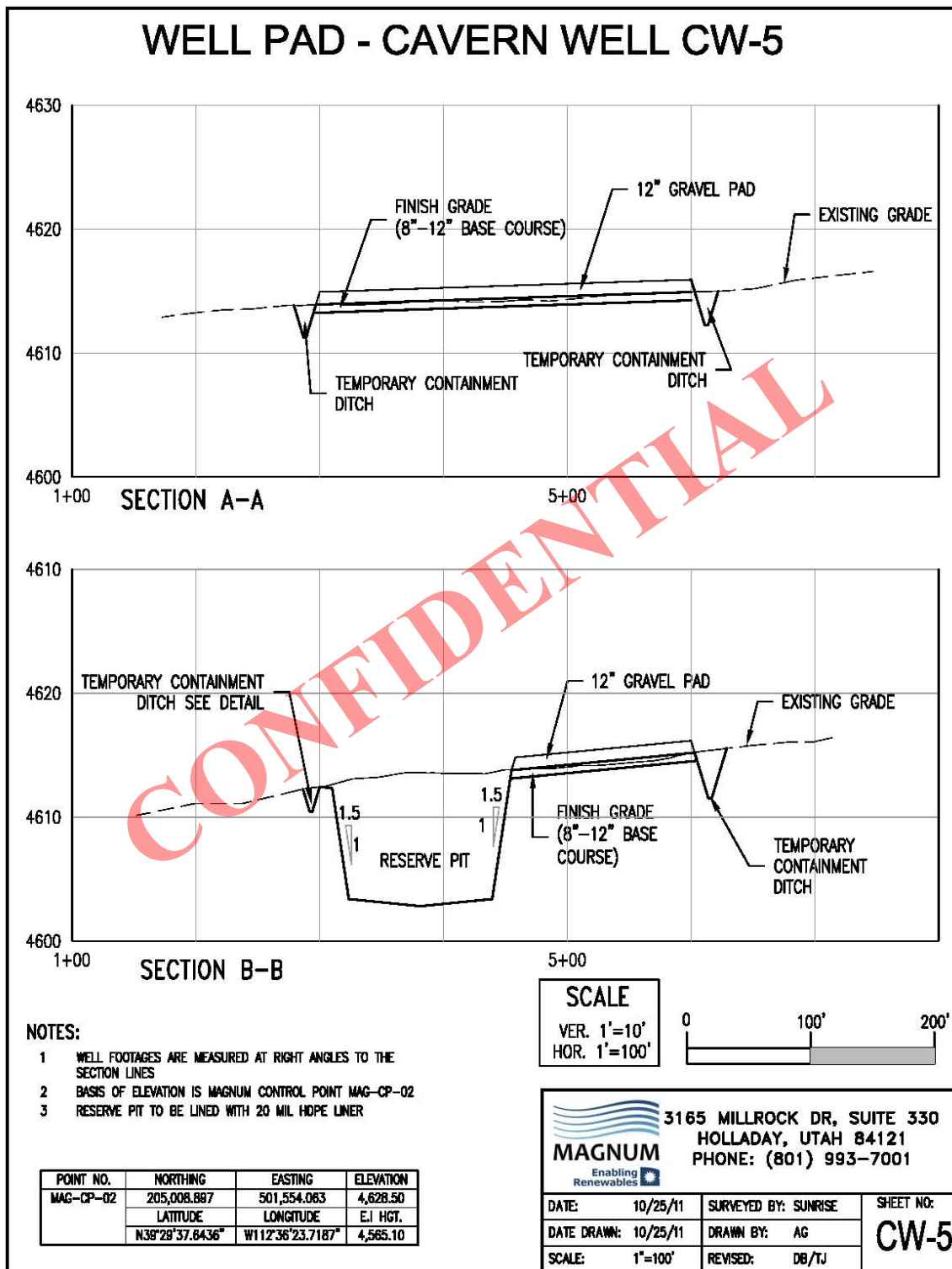


Exhibit C: Magnum Cavern Well 5 Well Pad Cross Sections



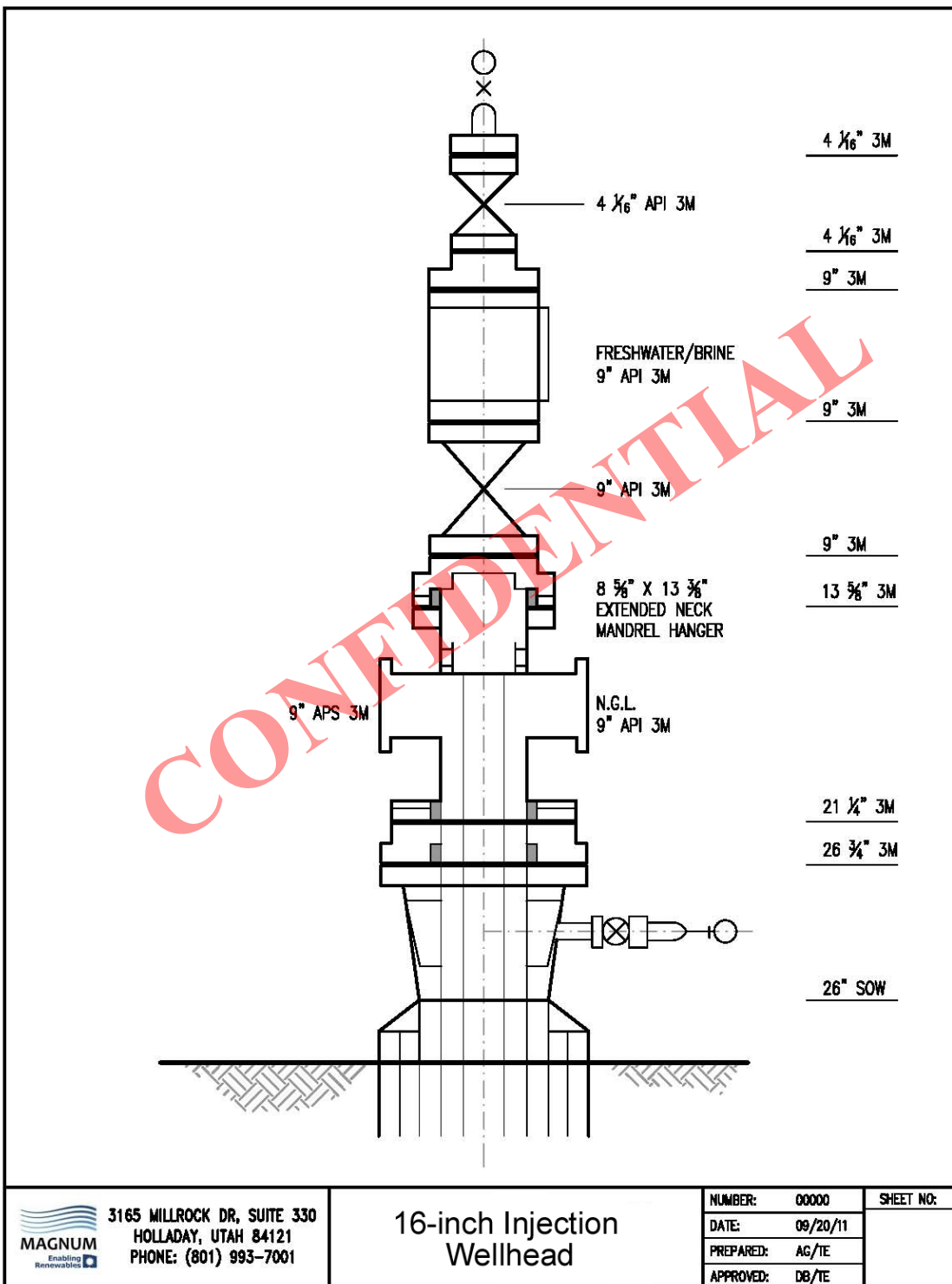


Exhibit D: Magnum Cavern Well 5 Injection Wellhead Design

# Application for Permit to Drill Magnum Cavern Well 5

## Certified Section Map and Plat Map

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10/31/2011

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*Prepared by*

**Magnum**

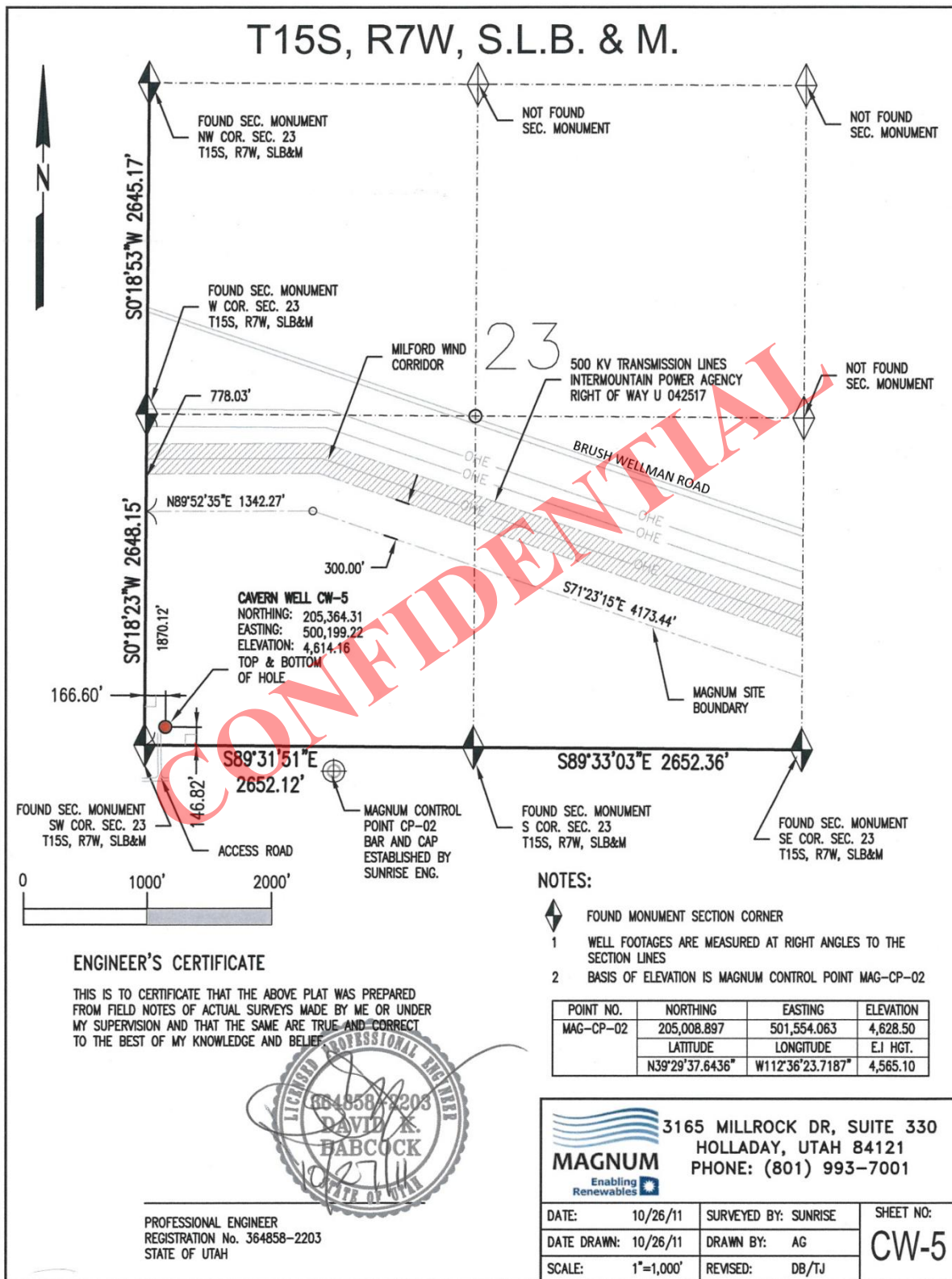
3165 E. Millrock Dr., Suite 330

Holladay, Utah 84121

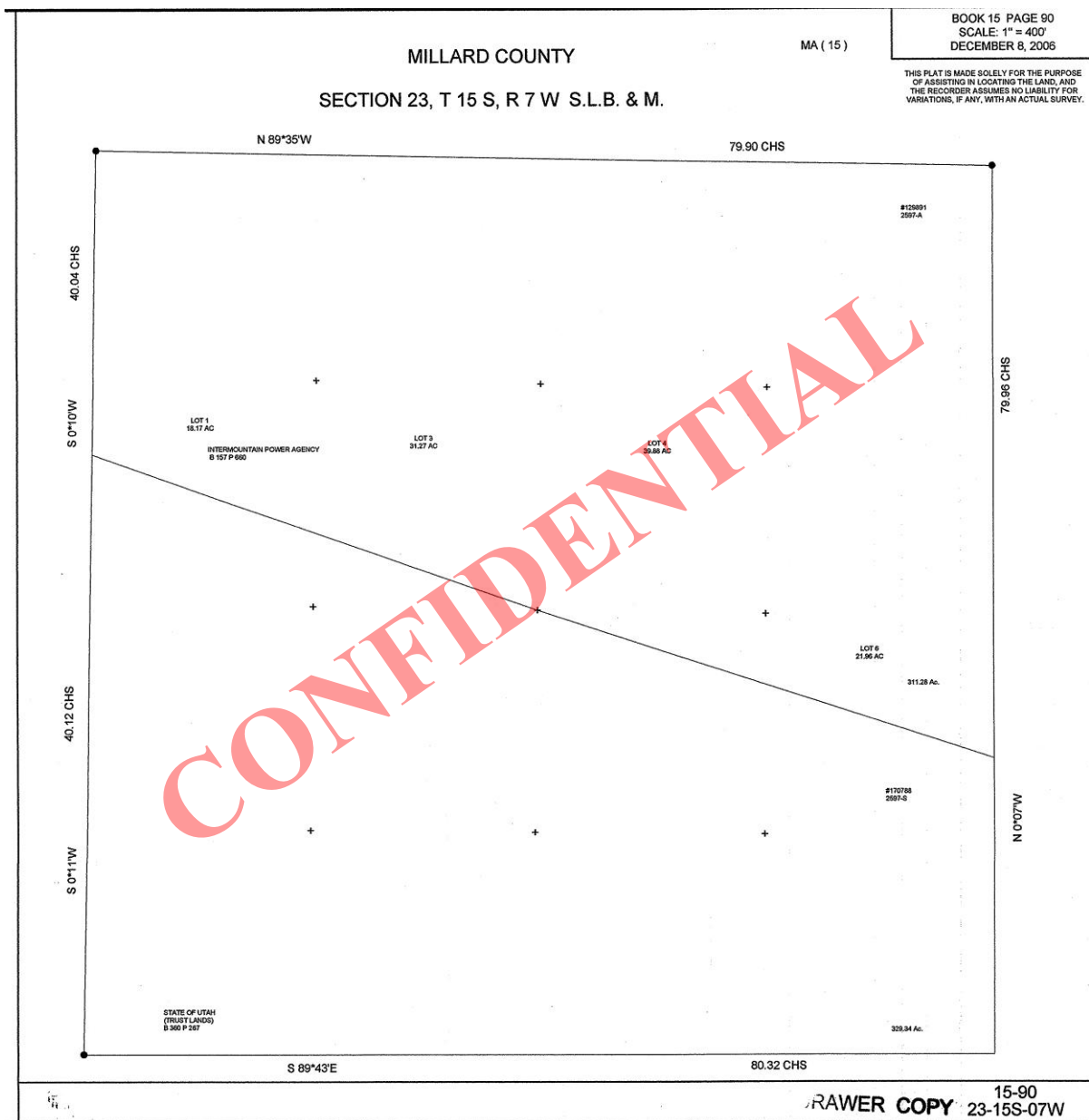
Tel 801 993 7001 Fax 801 993 7025

[www.westernenergyhub.com](http://www.westernenergyhub.com)

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Magnum Cavern Well 5 Certified Section Map



Magnum Cavern Well 5 Plat Map

# **Application for Permit to Drill Magnum Cavern Well 5**

## **Topographical Maps**

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**Magnum**

3165 E. Millrock Dr., Suite 330

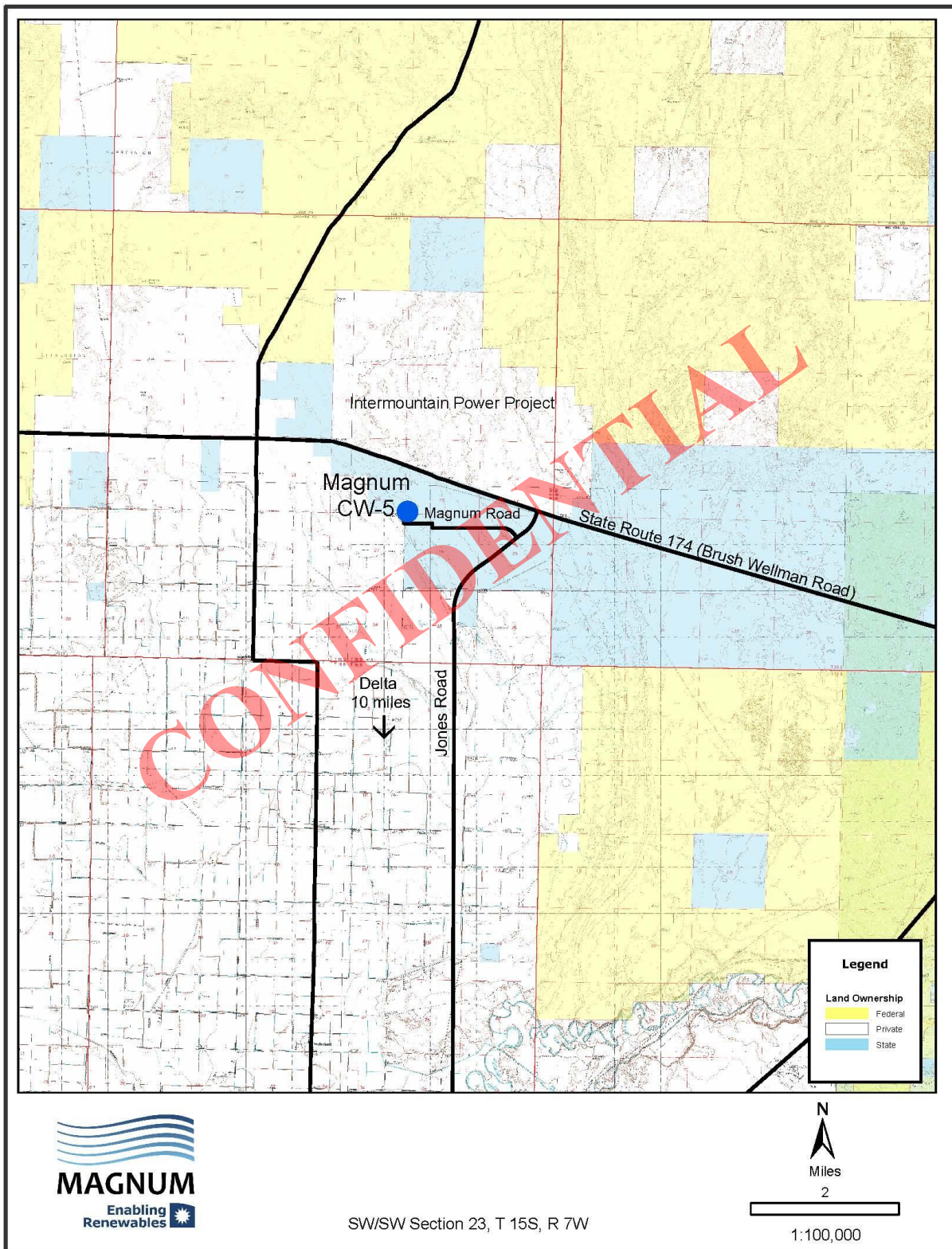
Holladay, Utah 84121

Tel 801 993 7001 Fax 801 993 7025

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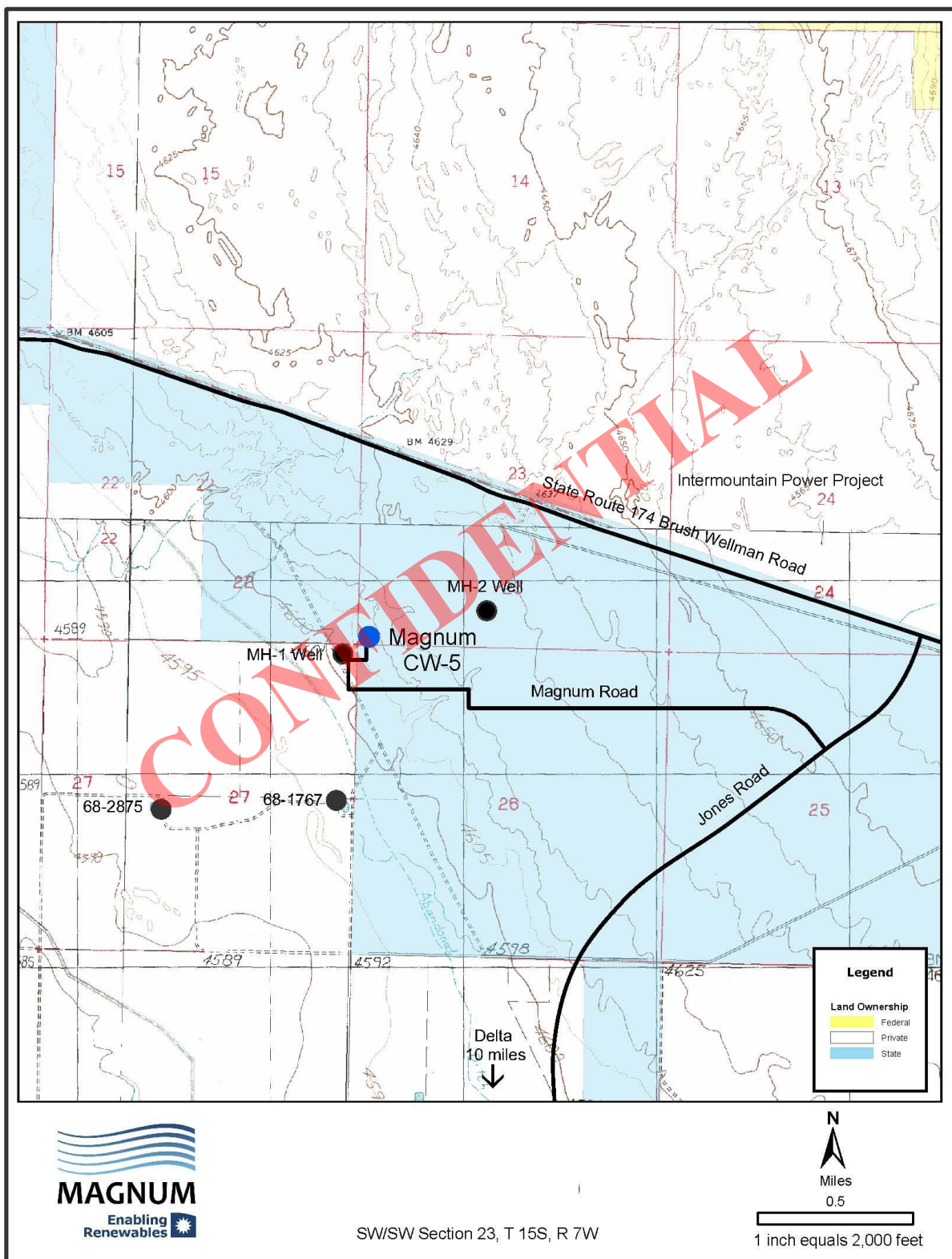
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Magnum Cavern Well 5 Regional Topographical Map





Magnum Cavern Well 5 Location Topographical Map

# **Application for Permit to Drill Storage Cavern Well 5**

## **Affidavit of Surface Owner Agreement**

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**FIRST AMENDMENT**

**To**

**ENERGY STORAGE AND DEVELOPMENT LEASE**

**STATE OF UTAH LEASE NUMBER 51573-OB**

**Between**

**THE STATE OF UTAH, acting through  
the SCHOOL AND INSTITUTIONAL  
TRUST LANDS ADMINISTRATION,  
as Lessor**

**and**

**MAGNUM HOLDINGS, LLC  
a Utah limited liability company,  
as Lessee**

**Effective as of June 1, 2009**

# FIRST AMENDMENT

To

## ENERGY STORAGE AND DEVELOPMENT LEASE STATE OF UTAH LEASE NUMBER ML 51573-OBA

THIS FIRST AMENDMENT TO ENERGY STORAGE AND DEVELOPMENT LEASE ("First Amendment"), is entered into effective as of the 1st day of June, 2009, by and between the STATE OF UTAH, acting by and through the SCHOOL AND INSTITUTIONAL TRUST LANDS ADMINISTRATION ("Lessor"), and MAGNUM HOLDINGS, L.L.C., a Utah limited liability company ("Lessee"). Lessor and Lessee are sometimes referred to herein as a "Party" or collectively as "Parties."

### RECITALS:

A. The Parties have previously entered into that certain Energy Storage and Development Lease, State of Utah Lease Number ML 51573-OBA, dated January 22, 2009 ("Lease"). Capitalized terms used, but not otherwise defined in this First Amendment, shall have the meanings assigned under the Lease.

B. Based on the results of the initial phase of cooperative exploration of the Leased Lands and the Private Lands, and as contemplated under Section 2.8 "Elimination of Surplus Lands," and Section 6.2(a) "Addition of Portions of Adjacent Lands," the Parties desire to amend the Lease to include certain Adjacent Lands in the Leased Lands as provided in this First Amendment.

C. With the exception of these adjustments in the Leased Lands, and corresponding adjustments in the annual minimum rental and other provisions regarding Lessee's use of and Lessor's retained rights in the Leased Lands all remaining provisions of the Lease remain in full force and effect.

### AGREEMENT:

IN CONSIDERATION of the foregoing recitals, the mutual promises contained herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Lessor and Lessee hereby agree as follows:

1.1 Pursuant to Section 2.8, "Elimination of Surplus Lands," Lessee hereby releases and Lessor hereby accepts and removes the following lands from the Leased Lands:

<u>Township 15 South, Range 7 West, SLD&amp;M</u>	<u>Surface/Mineral Acres</u>
Section 35: E/2NE	80.00
<u>Township 15 South, Range 7 West, SLD&amp;M</u>	<u>Minerals Only Acres</u>
Section 36: All	640.00

1.2 Pursuant to Section 6.2 (a), "Possible Addition of Portions of Adjacent Lands," Lessor hereby adds and Lessee hereby accepts the addition of the following lands to the Leased Lands. The Parties agree that the existing terms and conditions of the Lease constitute market based terms, and that the addition of these lands to the Leased Lands under these terms constitute a lease on market based terms within the intended meaning of Section 6.2 (a):

Township 15 South, Range 6 West, S1B&MSurface/ Mineral Acres

Section 19: E/2, SESW

360.00

Section 30: All (Lot 5(39.99), N/2, SW, N/2SE, SWSE

639.99

1.3 The reference in **Recital A** to the number of surface and mineral acres included in the Leased Lands is amended from "2,708" to "3,628," and the reference to the number of mineral only acres in the Leased Lands is amended from "1,581" to "941."

1.4 **Exhibit A**, "Leased Lands," and **Exhibit D**, "Project Area Map," attached hereto and by this reference incorporated herein, are hereby amended and replaced in their entirety to conform with and reflect the adjustments to the Leased Lands effected by **Sections 1.1 and 1.2** of this First Amendment.

1.5 The Annual Rent payable by Lessee under **Sections 4.1 and 4.2** prior to the Operations Commencement Date is amended [REDACTED]

1.6 The Minimum Fee payable by Lessee under **Section 4.8** from and after the Operations Commencement Date is amended [REDACTED]

1.7 With the exception of the foregoing amendments, the Lease and all remaining provisions thereof remain as currently drafted and in full force and effect, including without limitation Lessor's reserved rights under **Section 2.7** to, among other things, establish new rights of way and easements upon, through or over the Leased Lands in favor of third parties that will not unreasonably interfere with Lessee's Authorized Uses under this Lease.

**IN WITNESS WHEREOF**, the parties hereto have executed this First Amendment to be effective as of the day and year first written above.

**LESSOR:**

**STATE OF UTAH, ACTING THROUGH THE  
SCHOOL AND INSTITUTIONAL TRUST  
LANDS ADMINISTRATION**

By 

Kevin Carter, Director

Approved as to Form:

  
John W. Andrews, Special Assistant  
Attorney General

**LESSEE:**

**MAGNUM HOLDINGS, LLC**, a Utah limited liability  
company

By 

David K. Detton, Manager

**EXHIBIT A  
LEASED LANDS**

Township 15 South, Range 7 West, SLB&M Surface/ Mineral Acres

Section 16: E/2, E/2NW, SWNW, S/2SW	480.00
Section 21: NENE	40.00
Section 22: Lots 3(8.65), 5(22.21), 7(34.95), 8(35.45) SWNE, S/2NW, SE	381.26
Section 23: Lots 2(21.95), 4(8.82), 7(22.70), 8(35.87), SW, S/2SE	329.34
Section 24: Lots 3(9.36), 4(36.01), 6(22.63), 8(9.30), SWSW	117.30
Section 25: All	640.00
Section 26: All	640.00

Township 15 South, Range 6 West, SLB&M Surface/ Mineral Acres

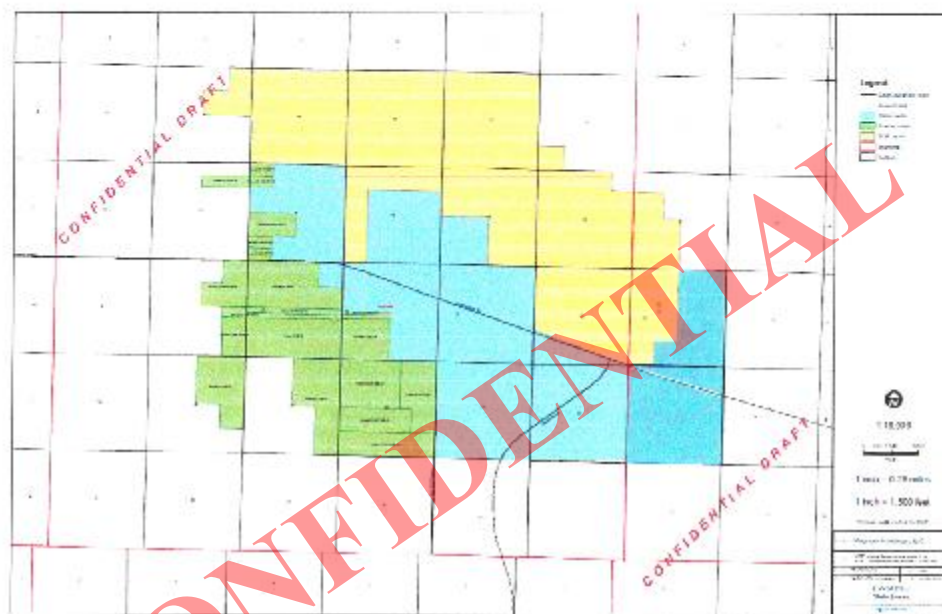
Section 19: E/2, S/2SW	360.00
Section 30: All (Lot 5(39.99), N/2, SW, N/2SE, SWSE )	639.99

Township 15 South, Range 7 West, SLB&M Minerals Only Acres

Section 14: SW	160.00
Section 15: S/2NE, SENW, E/2SW, SE	360.00
Section 22: Lots 1(40.34), 2(31.73), 4(18.13), 6(14.08), 9(5.05)	109.33
Section 23: Lots 1(18.17), 3(31.27), 5(39.88), 6(21.96), N/2N/2, SENE	311.28



**EXHIBIT D  
PROJECT AREA MAP**



**Application Checklist**

Complete	Requirement Description	Application Page
	1. A completed and signed Form 3 (application to drill, deepen or reenter). Make sure all blanks are filled and boxes are checked	Attached - Online
	2. Contact information and phone number for surface owner	Surface Use Plan p. 1-2
	3. Location plat	Certified Section Map and Plat Map
	4. Water Rights approval	Surface Use Plan p. A-1
	5. Estimated geologic markers	Drilling Plan Exhibit A, p. A-2
	6. Estimated top and bottom of anticipated water, oil, gas, other mineral zones and plans for their protection	Drilling Plan Exhibit A, p. A-2
	7. Plan for pressure control (BOPE), including schematic and casing test	Blowout Preventer
	8. Description of mud system, including mud weights	Drilling Plan p. 1-7, Table 1-1
	9. Plans for testing, logging and coring	Drilling Plan p. 1-2
	10. Expected bottom hole pressure, any anticipated abnormal pressures, temperatures, or hazards and plans for mitigation of them	Drilling Plan p. 1-2
	11. Casing design (size, type, weight)	Drilling Plan p. 2-1
	12. Cement design (type, weight, yield, estimated top, # sacks)	Drilling Plan p. 1-5
	13. Diagram of horizontal or directional well bore path including directional survey plan	Not Applicable
	14. Designation of agent if necessary	Not Applicable
	15. Bond	
	16. Affidavit of Surface Agreement	Affidavit of Surface Owner Agreement
	17. Exception location application (if needed)	Not Applicable
	18. Plat showing surface location, section and lease lines, target location, points along the well bore where owner consent has been obtained	Certified Section Map and Plat Map
	19. Reason for deviation	Not Applicable



# **Application for Permit to Drill Magnum Cavern Well 5**

Surface Use Plan



# Application for Permit to Drill Magnum Cavern Well 5

## Surface Use Plan

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10/31/2011

*Prepared by*

**Magnum**

3165 E. Millrock Dr., Suite 330

Holladay, Utah 84121

Tel 801 993 7001 Fax 801 993 7025

[www.westernenergyhub.com](http://www.westernenergyhub.com)

RECEIVED: October 31, 2011

## Table of Contents

<b>Section 1</b>	<b>Surface Use Plan .....</b>	<b>1-1</b>
1.1	Existing Roads .....	1-1
1.1.1	Directions to location .....	1-1
1.2	Access Roads .....	1-1
1.3	Location of Existing Wells within One Mile .....	1-1
1.4	Location of Production Facilities .....	1-1
1.5	Location and Type of Water Supply .....	1-2
1.6	Construction Materials .....	1-2
1.7	Methods of Disposing of Waste Materials .....	1-2
1.8	Ancillary Facilities .....	1-2
1.9	Well Site Layout .....	1-2
1.10	Plan for Restoration of Surface .....	1-2
1.11	Surface Ownership .....	1-2
1.12	Evidence of Water Rights .....	1-3
1.13	Other Information .....	1-3
1.14	Company Representative .....	1-3
<b>Appendices</b>		
Appendix A	Evidence of Water Rights .....	A-1

## Section 1

# Surface Use Plan

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## 1.1 Existing Roads

Access to the project from the east will be on State Route 174 (Brush Wellman Road) and Jones Road from the south. Existing roads will not be improved or changed (see **Magnum Gas Storage Regional Topographical Map**).

### 1.1.1 Directions to location

From Delta, Utah, head north on Road N 1000 W for 1.6 miles. Just after the road turns west and into Road W 1500 N, turn north onto Jones Road for approximately 7.4 miles. Turn west onto Magnum Road (to be constructed), approximately 0.5 miles south of the intersection of Brush Wellman Road, south of the Intermountain Power Plant. Travel approximately 1.5 miles to the Magnum Holdings (MH-1) water well. From MH-1, travel northeast to Cavern Well 5 (CW-5) well pad (to be constructed).

## 1.2 Access Roads

An access road will be constructed from Jones Road approximately 9,259 feet west to the MH-1 well. An additional access road will be constructed from MH-1 well approximately 275 feet east and then 230 feet north to the proposed CW-5 well pad. Access roads will generally be constructed to Millard County Road Design Standards. Construction will use the materials in place and additional material will be purchased from regional commercial pits and hauled to the site.

## 1.3 Location of Existing Wells within One Mile

There are three wells currently located within one mile of the proposed CW-5 (see **Magnum Gas Storage Location Topographical Map**):

- MH-1 supply well;
- 68-1767: abandoned well; and
- 68-2875: private irrigation well.

## 1.4 Location of Production Facilities

Production facilities will be installed on newly constructed drilling pad for CW-5 (see **Magnum Cavern Well 5 Location Topographical Map**, **Magnum Cavern Well 5 Plat Map** and **Magnum Cavern Well 5 Certified Section Map**). Five utility lines will be constructed:

- Electric supply line;
- Brine discharge/supply line;
- Raw water line;



- Well water supply line; and
- Natural gas products line.

All temporary disturbed areas related to production facilities will be reclaimed.

## **1.5 Location and Type of Water Supply**

Water for drilling will be supplied by Magnum MH-1 and MH-2 wells. MH-1 well is located to the southwest and MH-2 well is located to the northeast of the proposed CW-5 well (See **Magnum Cavern Well 5 Location Topographical Map**).

## **1.6 Construction Materials**

Soil for construction will come from the site. Gravel will be purchased from a local supply vendor. Piping will be purchased from a supply vendor and stored on site.

## **1.7 Methods of Disposing of Waste Materials**

Drill cuttings will settle out in the reserve pit. The reserve pit will be lined with a 20-mil HDPE liner (see **Magnum Cavern Well 5 Well Pad**). The cuttings will be hauled off and disposed of at an approved facility by contractor. Liquids in the pit will be evaporated. Any remaining liquids will be disposed of at an approved disposal site by the contractor. Sewage facilities and disposal will be furnished and maintained by a local vendor. All garbage will be stored in appropriate containers and regularly hauled off-site to an approved facility.

## **1.8 Ancillary Facilities**

After drilling is complete, modular solution mining facilities will be installed in the southwest portion of the CW-5 well pad for solution mining of the storage cavern.

## **1.9 Well Site Layout**

**Magnum Cavern Well 5 Well Pad** and **Magnum Cavern Well 5 Cross Sections** depicts the well site layout. As shown: the drill rig will be set up in the northwest portion of the pad; the reserve pit will be located in the southwest corner of the location; the pipe racks will be located east of the drill rig.

## **1.10 Plan for Restoration of Surface**

Restoration of all temporarily disturbed areas around the CW-5 well pad will be graded and reseeded according to The Utah School and Institutional Trust Lands Administration (SITLA) requirements.

## **1.11 Surface Ownership**

SITLA is the owner and land administrator for Section 23 T15S, R7W. Magnum Holdings, LLC currently holds an Energy Storage and Development Lease (Number 51573-OBA) from SITLA to develop the property. A redacted copy of the First Amendment to the Lease Agreement describing the leased land has been provided in the Affidavit of Surface Owner Agreement. SITLA can be reached at:

Application for Permit to Drill  
Magnum Cavern Well 5

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State Institutional Trust Lands Administration  
675 East 500 South  
Suite 500  
Salt Lake City, UT 84102  
801-538-5100  
Attn: LaVonne Garrison

### **1.12 Evidence of Water Rights**

The State Engineer has approved multiple Temporary Change Applications allowing use of existing water rights at the Project site. The Order approves the Temporary Change Application of the City of Delta (Number 68-396). A copy of the Order has been provided in **Appendix A**. This Order is representative of similar Orders received by Magnum for the Project. At this time, water will be withdrawn from the existing MH-1 well and the proposed MH-2 well (see **Magnum Cavern Well 5 Location Topographical Map** for details).

### **1.13 Other Information**

- Current vegetation at the site consists of open scrub/shrub with sagebrush, greasewood, rabbitbrush, saltbush, and mixed bunchgrasses.
- Magnum has received all environmental clearances from Division of Wildlife Resources and Utah State Historic Preservation Office.

### **1.14 Company Representative**

Tiffany A. James  
Director, Government Relations  
and Environmental Services  
Magnum Gas Storage, LLC  
3165 East Millrock Drive, Suite 330  
Holladay, UT 84121  
Phone: (801) 993-7001  
Cell: (801) 719-9131  
[tjames@westernenergyhub.com](mailto:tjames@westernenergyhub.com)

Appendix A

# **Evidence of Water Rights**

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CONFIDENTIAL



GARY R. HERBERT  
Governor  
GREG BELL  
Lieutenant Governor

## State of Utah

### DEPARTMENT OF NATURAL RESOURCES

#### Division of Water Rights

MICHAEL R. STYLER  
Executive Director

KENT L. JONES  
State Engineer/Division Director

### ORDER OF THE STATE ENGINEER

#### For Temporary Change Application Number 68-396 (t37232)

Temporary Change Application Number 68-396 (t37232) in the name of Delta City, was filed on March 22, 2011, to add additional points of diversion, add an additional place(s) of use and change the nature of use of 2.6305 cubic feet per second (cfs) or 1029.29 acre-feet (af) of water as evidenced by Water Right Numbers 68-2835, 68-2909, and 68-396. Heretofore, the water has been diverted from the following points located: (1) Well - South 340 feet and West 1550 feet from the E $\frac{1}{4}$  Corner of Section 12, T17S, R7W, SLB&M (existing 16-inch well, 856 feet deep); (2) Well - North 191 feet and East 916 feet from the SW Corner of Section 27, T16S, R6W, SLB&M (existing 16-inch well, 1000 feet deep); (3) Well - South 30 feet and West 20 feet from the NE Corner of Section 17, T17S, R6W, SLB&M (existing 16-inch well, 834 feet deep); (4) Well - North 1590 feet and East 719 feet from the SW Corner of Section 6, T17S, R7W, SLB&M (existing 14-inch well, 737 feet deep); (5) Well - South 594 feet and West 1334 feet from the NE Corner of Section 12, T17S, R7W, SLB&M (existing 10-inch well, 703 feet deep); (6) Well - North 2761 feet and West 144 feet from the E $\frac{1}{4}$  Corner of Section 12, T17S, R7W, SLB&M (existing 12-inch well, 860 feet deep). The water was used for municipal purposes within the service area of Delta. The water was used in all or portion(s) of Section 33, T16S, R6W, SLB&M; Section 34, T16S, R6W, SLB&M; Section 3, T17S, R6W, SLB&M; and Section 4, T17S, R6W, SLB&M.

Hereafter, it is proposed to divert 2.6305 cfs or 998.49 acre-feet of water from the same points as heretofore and from additional points located: (1) Well - North 15 feet and East 2895 feet from the SW Corner of Section 23, T15S, R7W, SLB&M (16-inch well, 1500 feet deep); (2) Well - South 30 feet and West 60 feet from the NE Corner of Section 27, T15S, R7W, SLB&M (16-inch well, 1500 feet deep); (3) Well - South 335 feet and East 2070 feet from the NW Corner of Section 26, T15S, R7W, SLB&M (16-inch well, 1500 feet deep); (4) Well - North 555 feet and East 2180 feet from the SW Corner of Section 23, T15S, R7W, SLB&M (16-inch well, 1500 feet deep); (5) Well - North 205 feet and East 1355 feet from the SW Corner of Section 23, T15S, R7W, SLB&M (16-inch well, 1500 feet deep). The nature of use of the water is being changed to the irrigation of 5.00 acres from April 1 to October 31, the indoor domestic requirements of 20 equivalent domestic units from January 1 to December 31, and for industrial purposes (Industrial Processes & Associated Activities). The place of use of the water is to remain the same as heretofore, but adding all or portion(s) of Section 19, T15S, R6W, SLB&M; Section 30, T15S, R6W, SLB&M; Section 22, T15S, R7W, SLB&M; Section 23, T15S, R7W, SLB&M; Section 24, T15S, R7W, SLB&M; Section 25, T15S, R7W, SLB&M; Section 26, T15S, R7W, SLB&M; and Section 27, T15S, R7W, SLB&M.

The application was not advertised.

1594 West North Temple, Suite 220, PO Box 146300, Salt Lake City, UT 84114-6300  
telephone (801) 538-7240 • facsimile (801) 538-7467 • [www.waterrights.utah.gov](http://www.waterrights.utah.gov)

ORDER OF THE STATE ENGINEER  
Temporary Change Application Number  
68-396 (t37232)  
Page 2

Review has been made of the proposed changes, the underlying right, and the protest. In order to approve this temporary change application without enlarging the underlying water rights the quantification limiting water right 68-2909 (a27062) to 172.43 acre-feet, as described in the approval memorandum for change application (a27062), must be continued. The quantified amounts for water right 68-396 is 0.893 cfs or 646.5 acre-feet and water right 68-2835 is 1.10 cfs or 179.56 acre-feet. Therefore, the total amount limited under these rights is: (172.43 acre-feet + 646.5 acre-feet + 179.56 acre-feet = 998.49 acre-feet).

In evaluating applications which propose to change the nature of use of a water right, the State Engineer believes it is appropriate to examine the rates and amounts of hydrologic depletion associated with the historical water use as compared to the proposed use to assure that there is no enlargement of the underlying water right. The hereafter irrigation and domestic uses were administratively assigned to Temporary Change Application t36003 (68-263) leaving only industrial uses to be evaluated under this application. In this case, it is believed that the historical water uses would have incurred the following rates and amounts of hydrologic depletion:

<u>Prior</u> <u>Beneficial Use</u>	<u>Rate of</u> <u>Diversion</u>	<u>Amount of</u> <u>Diversion</u>	<u>*Rate of</u> <u>Depletion</u>	<u>Amount of</u> <u>Depletion</u>
Municipal 12.5 acres	998.49 acre-feet	998.49 acre-feet	100 percent	998.49 acre-feet

The rate and amount of hydrologic depletion associated with the proposed use is as follows:

<u>Proposed</u> <u>Beneficial Use</u>	<u>Rate of</u> <u>Diversion</u>	<u>Amount of</u> <u>Diversion</u>	<u>*Rate of</u> <u>Depletion</u>	<u>Amount of</u> <u>Depletion</u>
Industrial Use	998.49 acre-feet	998.49 acre-feet	100 percent	998.49 acre-feet

*\*Consumptive Use of Irrigated Crops in Utah, Research Report 145, Utah Agricultural Experiment Station, Utah State University, Logan, Utah, October 1994, Delta Station.*

Based upon the above analysis, it appears that the proposed use will not exceed the hydrologic depletion limitations associated with the historical uses, thus causing an enlargement of the underlying water right.

It is the opinion of the State Engineer that this application can be approved without adversely affecting prior rights provided certain conditions are imposed. Therefore, the applicant is put on notice that diligence must be shown in pursuing the development of this application, which can be demonstrated by the completion of the project as approved in this order of the State Engineer. It is, therefore, **ORDERED** and Temporary Change Application Number 68-396 (t37232) is hereby **APPROVED** subject to prior rights and with the following conditions:

- 1) The amount of water diverted by the applicant from the wells shall be limited to 2.6305 cfs or 998.49 acre-feet annually to be used for



ORDER OF THE STATE ENGINEER  
Temporary Change Application Number  
68-396 (t37232)  
Page 3

industrial use. The depletion shall be limited to the historical depletion of 998.49 acre-feet.

- 2) To accommodate the use approved under this application, the historic municipal use shall cease.
- 3) Section 73-5-4 of the Utah Code provides that "every person using water in this state shall construct or install and maintain ...controlling works...and measuring device at each point where water is diverted or turned out, for the purpose of regulating and measuring the quantity of water that may be used..." Adequate measuring and totalizing devices shall be installed on the heretofore and hereafter points of diversions. The applicant must maintain a record and prepare a report of the amount of water diverted from each diversion point. This annual report of water diverted shall be submitted to the State Engineer on or before December 31<sup>st</sup> of each operational year of the project. Failure to comply could result in an order to cease the use of water and/or the revocation of this approval.
- 4) **This application shall automatically expire December 31, 2011.**

**It is the applicant's responsibility to maintain a current address with this office and to update ownership of their water right. Please notify this office immediately of any change of address or for assistance in updating ownership.**

Your contact with this office, should you need it, is with the Sevier River/Southern Regional Office. The telephone number is 435-896-4429.

This Order is subject to the provisions of Administrative Rule R655-6-17 of the Division of Water Rights and to Sections 63G-4-302, 63G-4-402, and 73-3-14 of the Utah Code which provide for filing either a Request for Reconsideration with the State Engineer or an appeal with the appropriate District Court. A Request for Reconsideration must be filed with the State Engineer within 20 days of the date of this Order. However, a Request for Reconsideration is not a prerequisite to filing a court appeal. A court appeal must be filed within 30 days after the date of this Order, or if a Request for Reconsideration has been filed, within 30 days after the date the Request for Reconsideration is denied. A Request for Reconsideration is considered denied when no action is taken 20 days after the Request is filed.

Dated this 28 day of March, 2011.

  
Kirk Forbush, P.E., Region Engineer



# Application for Permit to Drill Magnum Cavern Well 5

## Blowout Preventer

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10/31/2011

(revised 02/02/2012)

*Prepared by*

**Magnum**

3165 E. Millrock Dr., Suite 330

Holladay, Utah 84121

Tel 801 993 7001 Fax 801 993 7025

[www.westernenergyhub.com](http://www.westernenergyhub.com)

RECEIVED: October 31, 2011

## 16-Inch Cavern Well Blowout Preventer Equipment

The geology of the area is known from the nearby Magnum MH-1 well and the Argonaut Well as well as the nearby industrial water wells. These wells demonstrate that the formations to be drilled above the salt, and the salt itself, are gas-free. The Argonaut Well penetrated the entire sequence of salt to a depth of 11,266 feet bgs and the Magnum MH-1 well penetrated the salt to a depth of 6,420 feet bgs. This is deeper than the intended Cavern Well 5 depth of 5,050 bgs. Additionally, the geophysical lines that run over the area show there are no structures present in the overlying formations that could trap gas. This is typical of the basin and range deposits that have been explored for hydrocarbon production.

Wells drilled into salt generally utilize some kind of blowout control equipment. The blowout control equipment almost always includes an annular, bag-type blowout preventer. Magnum will follow industry practice and use an annular blowout preventer (BOP) when drilling Cavern Well 5 (see **Blowout Preventer**). Additional equipment used in deep oil and gas wells, such as shear and pipe rams, will not be used for drilling Magnum's cavern well.

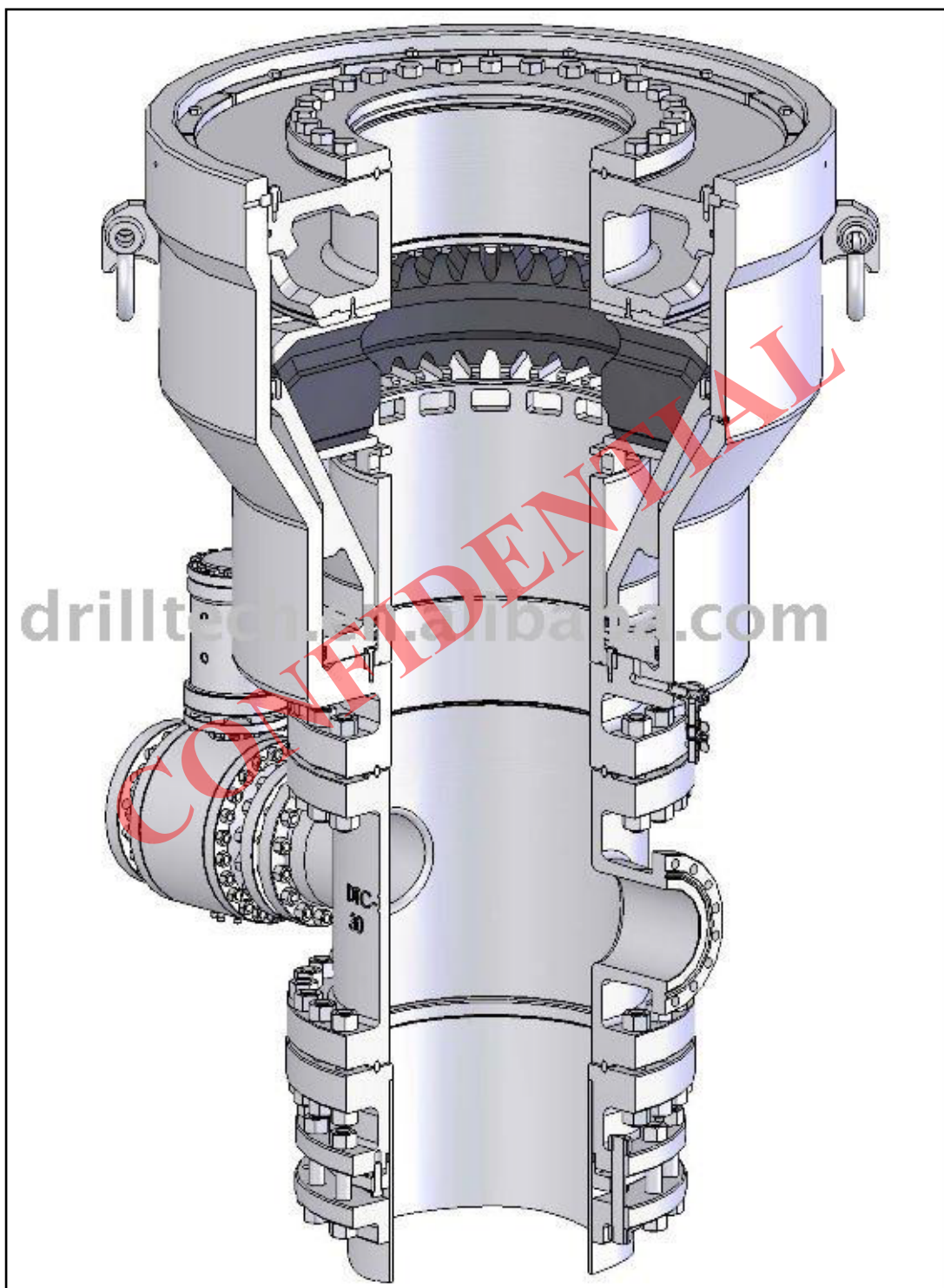
Magnum intends to install BOP measures beginning with the 30-inch surface casing at a depth of 750 feet and the BOP will be in place during the drilling for the 24- and 20-inch casings. The exact size of the BOP to be used will be at least 20-inches in diameter and rated at 5000 psi. Installation of the BOP measures are described in detail in Section 1.2 of the Drilling/Well Construction Plan and both the installation and testing process is summarized below.

The BOP will be installed on the surface casing after it is cemented in place. The BOP will be installed on a temporary flange welded to a 20-inch reducer on the 30-inch casing. The size of the 16-inch cavern well requires that the bottom hole assembly be run into the well, the BOP equipment stripped over the drilling assembly, and the BOP re-installed on the surface casing. The BOP equipment must be stripped off and then put back over the drilling string whenever a bit change is required.

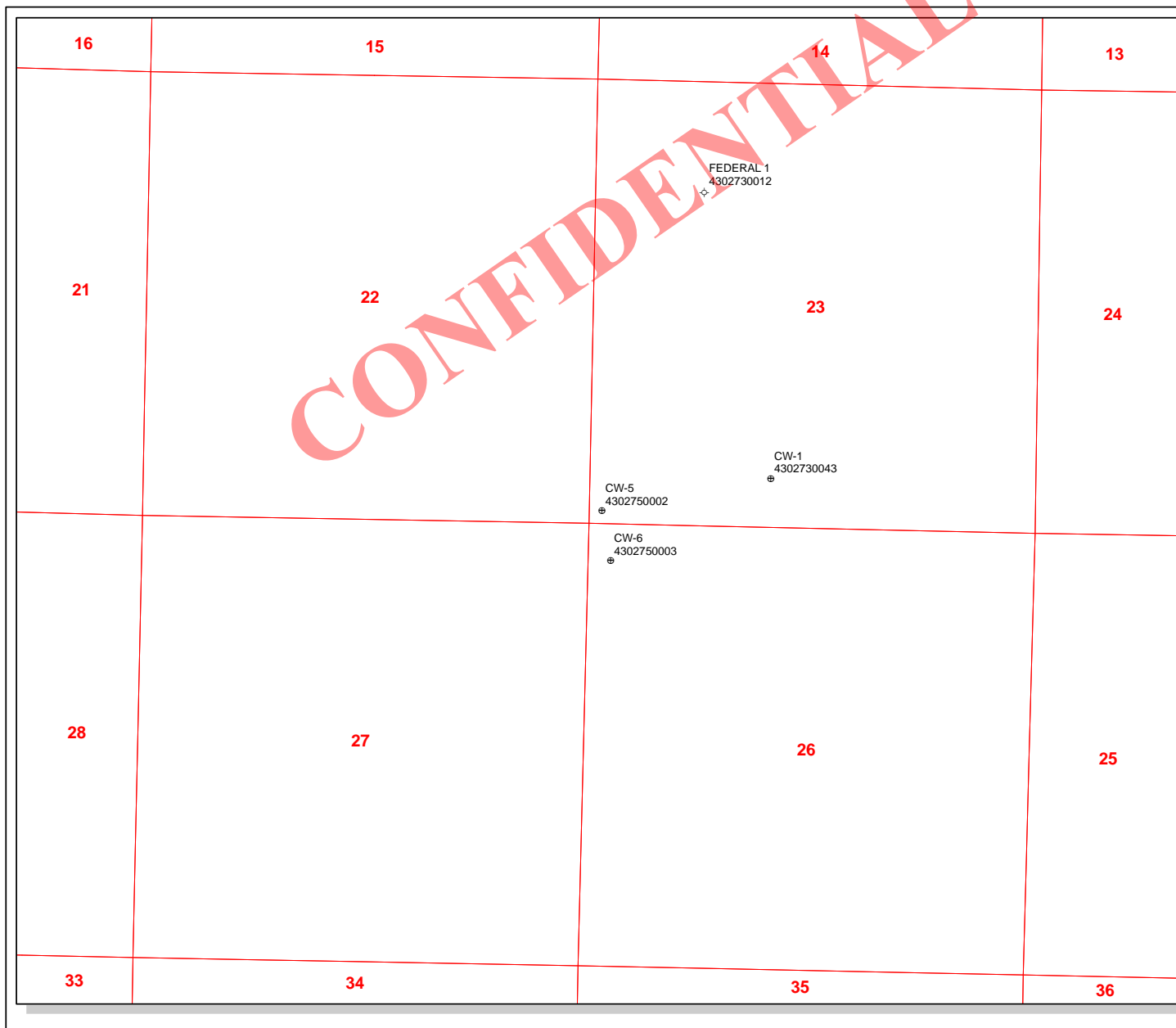
Once the BOP is installed, testing of the equipment will follow oil and gas industry standards. Functionality testing of the equipment is conducted every time it is installed. The BOP will be connected to the closing unit by high-pressure hydraulic hoses. A joint of drill pipe will be picked up by the rig and run into the BOP. The BOP will then be closed from the control unit and checked that the bag has sealed around the drill pipe. If the closing is visually correct, the BOP will be opened, the drill pipe removed and rig activities will continue.

### Sources

<https://www.drilltech.en.alibaba.com>



Magnum Cavern Well 5 Blowout Preventer



API Number: 4302750002

Well Name: CW-5

Township T1.5 . Range R0.7 . Section 23

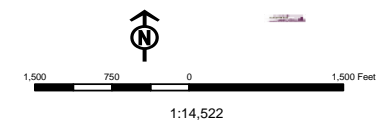
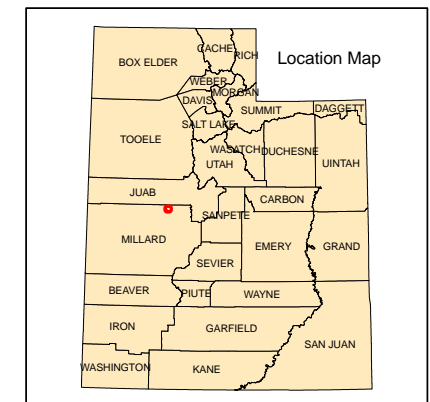
Meridian: SLBM

Operator: MAGNUM SOLUTION MINING, LLC

Map Prepared:

Map Produced by Diana Mason

Units	STATUS	Wells Query	Status
	ACTIVE	APD - Approved Permit	APD - Approved Permit
	EXPLORATORY	DRL - Spudded (Drilling Commenced)	DRL - Spudded (Drilling Commenced)
	GAS STORAGE	GW - Gas Injection	GW - Gas Injection
	NF PP OIL	GS - Gas Storage	GS - Gas Storage
	NF SECONDARY	LA - Location Abandoned	LA - Location Abandoned
	PI OIL	LOC - New Location	LOC - New Location
	PP GAS	OPS - Operation Suspended	OPS - Operation Suspended
	PP GEOTHERMAL	PA - Plugged Abandoned	PA - Plugged Abandoned
	PP OIL	PGW - Producing Gas Well	PGW - Producing Gas Well
	SECONDARY	POW - Producing Oil Well	POW - Producing Oil Well
	TERMINATED	RET - Returned APD	RET - Returned APD
Fields	STATUS		
	Unknown	SGW - Shut-in Gas Well	SGW - Shut-in Gas Well
	ABANDONED	SOW - Shut-in Oil Well	SOW - Shut-in Oil Well
	ACTIVE	TA - Temp. Abandoned	TA - Temp. Abandoned
	COMBINED	TW - Test Well	TW - Test Well
	INACTIVE	WDW - Water Disposal	WDW - Water Disposal
	STORAGE	WW - Water Injection Well	WW - Water Injection Well
	TERMINATED	WSW - Water Supply Well	WSW - Water Supply Well



Well Name	MAGNUM SOLUTION MINING, LLC CW-5 43027500020000			
String	COND	SURF	I1	I2
Casing Size(in)	36.000	30.000	24.000	20.000
Setting Depth (TVD)	150	750	3200	3350
Previous Shoe Setting Depth (TVD)	0	150	750	3200
Max Mud Weight (ppg)	8.3	9.5	10.2	10.2
BOPE Proposed (psi)	0	0	5000	5000
Casing Internal Yield (psi)	1280	1500	3790	4450
Operators Max Anticipated Pressure (psi)	700			4.0

Calculations	COND String	36.000	"
Max BHP (psi)	.052*Setting Depth*MW=	65	
			BOPE Adequate For Drilling And Setting Casing at Depth?
MASP (Gas) (psi)	Max BHP-(0.12*Setting Depth)=	47	NO
MASP (Gas/Mud) (psi)	Max BHP-(0.22*Setting Depth)=	32	NO OK
			*Can Full Expected Pressure Be Held At Previous Shoe?
Pressure At Previous Shoe	Max BHP-.22*(Setting Depth - Previous Shoe Depth)=	32	NO
Required Casing/BOPE Test Pressure=		0	psi
*Max Pressure Allowed @ Previous Casing Shoe=		0	psi *Assumes 1psi/ft frac gradient

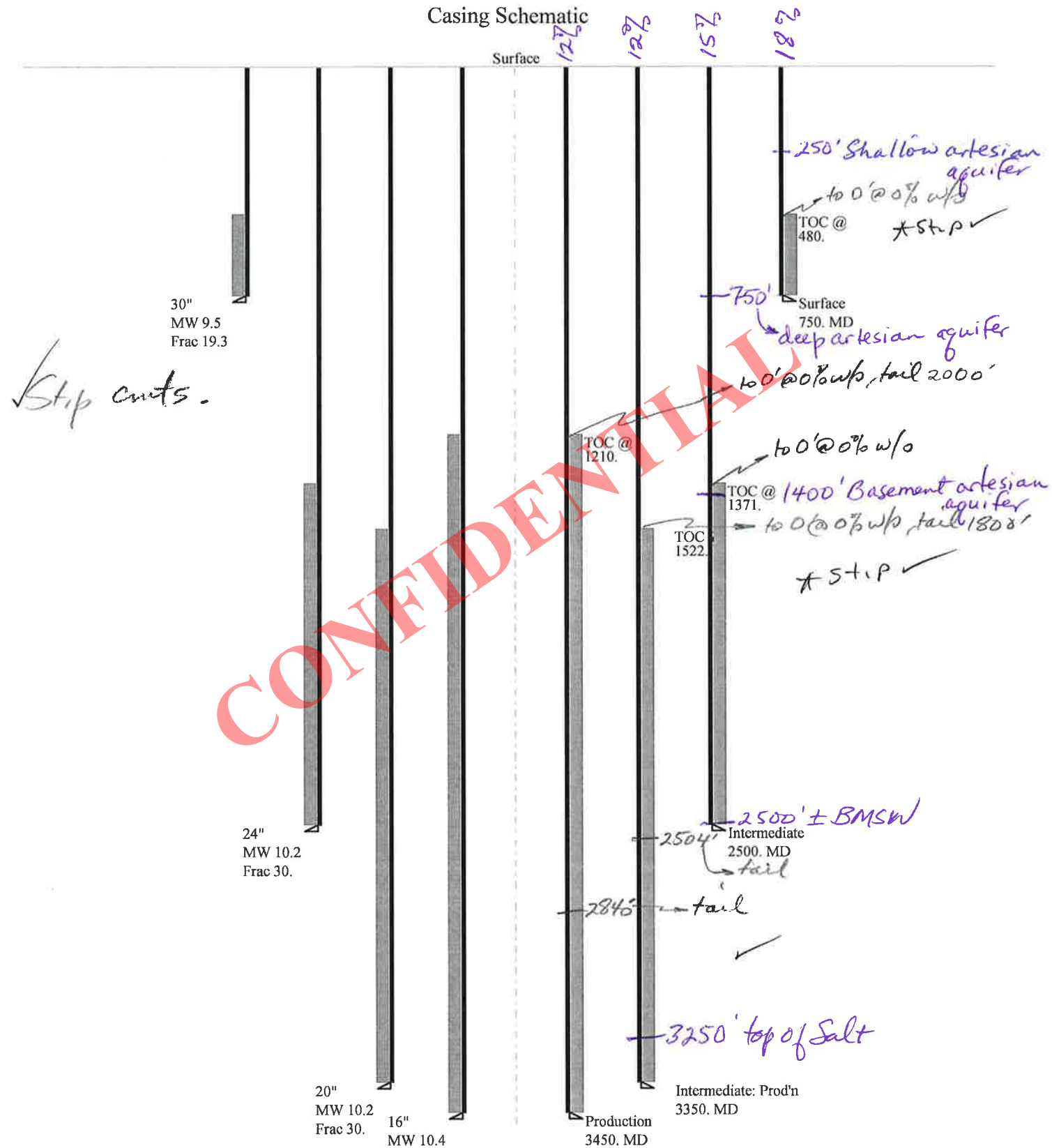
Calculations	SURF String	30.000	"
Max BHP (psi)	.052*Setting Depth*MW=	374	
			BOPE Adequate For Drilling And Setting Casing at Depth?
MASP (Gas) (psi)	Max BHP-(0.12*Setting Depth)=	281	NO
MASP (Gas/Mud) (psi)	Max BHP-(0.22*Setting Depth)=	206	NO OK
			*Can Full Expected Pressure Be Held At Previous Shoe?
Pressure At Previous Shoe	Max BHP-.22*(Setting Depth - Previous Shoe Depth)=	239	NO OK
Required Casing/BOPE Test Pressure=		750	psi
*Max Pressure Allowed @ Previous Casing Shoe=		150	psi *Assumes 1psi/ft frac gradient

Calculations	I1 String	24.000	"
Max BHP (psi)	.052*Setting Depth*MW=	1697	
			BOPE Adequate For Drilling And Setting Casing at Depth?
MASP (Gas) (psi)	Max BHP-(0.12*Setting Depth)=	1313	YES
MASP (Gas/Mud) (psi)	Max BHP-(0.22*Setting Depth)=	993	YES OK
			*Can Full Expected Pressure Be Held At Previous Shoe?
Pressure At Previous Shoe	Max BHP-.22*(Setting Depth - Previous Shoe Depth)=	1158	NO OK
Required Casing/BOPE Test Pressure=		2653	psi
*Max Pressure Allowed @ Previous Casing Shoe=		750	psi *Assumes 1psi/ft frac gradient

Calculations	I2 String	20.000	"
Max BHP (psi)	.052*Setting Depth*MW=	1777	
			BOPE Adequate For Drilling And Setting Casing at Depth?
MASP (Gas) (psi)	Max BHP-(0.12*Setting Depth)=	1375	YES
MASP (Gas/Mud) (psi)	Max BHP-(0.22*Setting Depth)=	1040	YES OK
			*Can Full Expected Pressure Be Held At Previous Shoe?
Pressure At Previous Shoe	Max BHP-.22*(Setting Depth - Previous Shoe Depth)=	1744	YES OK
Required Casing/BOPE Test Pressure=		3115	psi
*Max Pressure Allowed @ Previous Casing Shoe=		3200	psi *Assumes 1psi/ft frac gradient

## 43027500020000 CW-5

## Casing Schematic





Well name:	<b>43027500020000 CW-5</b>	
Operator:	<b>Magnum Solution Mining, LLC</b>	
String type:	Surface	Project ID: 43-027-50002
Location:	MILLARD COUNTY	

**Design parameters:****Collapse**

Mud weight: 9.500 ppg  
Design is based on evacuated pipe.

**Minimum design factors:****Collapse:**

Design factor 1.125

**Burst:**

Design factor 1.00

**Environment:**

H2S considered? No  
Surface temperature: 74 °F  
Bottom hole temperature: 84 °F  
Temperature gradient: 1.40 °F/100ft  
Minimum section length: 12 ft

Cement top: 480 ft

**Burst**

Max anticipated surface pressure: 660 psi  
Internal gradient: 0.120 psi/ft  
Calculated BHP 750 psi

No backup mud specified.

**Tension:**

8 Round STC: 1.80 (J)  
8 Round LTC: 1.70 (J)  
Buttress: 1.60 (J)  
Premium: 1.50 (J)  
Body yield: 1.50 (B)

Tension is based on air weight.  
Neutral point: 641 ft

**Non-directional string.****Re subsequent strings:**

Next setting depth: 3,200 ft  
Next mud weight: 10.200 ppg  
Next setting BHP: 1,696 psi  
Fracture mud wt: 19.250 ppg  
Fracture depth: 750 ft  
Injection pressure: 750 psi

Run Seq	Segment Length (ft)	Size (in)	Nominal Weight (lbs/ft)	Grade	End Finish	True Vert Depth (ft)	Measured Depth (ft)	Drift Diameter (in)	Est. Cost (\$)
1	750	30	234.32	A-53 B	Quik-Stab FOD-9	750	750	24	69300
Run Seq	Collapse Load (psi)	Collapse Strength (psi)	Collapse Design Factor	Burst Load (psi)	Burst Strength (psi)	Burst Design Factor	Tension Load (kips)	Tension Strength (kips)	Tension Design Factor
1	370	740	1.999	750	1500	2.00	175.7	2412.2	13.73 B

Prepared by: Helen Sadik-Macdonald  
Div of Oil, Gas & Mining

Phone: 801 538-5357  
FAX: 801-359-3940

Date: January 24, 2012  
Salt Lake City, Utah

**Remarks:**

Collapse is based on a vertical depth of 750 ft, a mud weight of 9.5 ppg. The casing is considered to be evacuated for collapse purposes. Collapse strength is based on the Westcott, Dunlop & Kemler method of biaxial correction for tension.

Burst strength is not adjusted for tension.

Well name:	<b>43027500020000 CW-5</b>	
Operator:	<b>Magnum Solution Mining, LLC</b>	
String type:	Intermediate	Project ID: 43-027-50002
Location:	MILLARD COUNTY	

**Design parameters:****Collapse**

Mud weight: 10.200 ppg  
Design is based on evacuated pipe.

**Minimum design factors:****Collapse:**

Design factor 1.125

**Burst:**

Design factor 1.00

**Environment:**

H2S considered? No  
Surface temperature: 74 °F  
Bottom hole temperature: 109 °F  
Temperature gradient: 1.40 °F/100ft  
Minimum section length: 1,000 ft

Cement top: 1,371 ft

**Burst**

Max anticipated surface pressure: 1,038 psi  
Internal gradient: 0.220 psi/ft  
Calculated BHP 1,588 psi

No backup mud specified.

**Tension:**

8 Round STC: 1.80 (J)  
8 Round LTC: 1.80 (J)  
Buttress: 1.60 (J)  
Premium: 1.50 (J)  
Body yield: 1.60 (B)

Tension is based on air weight.  
Neutral point: 2,110 ft

**Non-directional string.****Re subsequent strings:**

Next setting depth: 3,350 ft  
Next mud weight: 10.200 ppg  
Next setting BHP: 1,775 psi  
Fracture mud wt: 30.000 ppg  
Fracture depth: 2,500 ft  
Injection pressure: 3,896 psi

Run Seq	Segment Length (ft)	Size (in)	Nominal Weight (lbs/ft)	Grade	End Finish	True Vert Depth (ft)	Measured Depth (ft)	Drift Diameter (in)	Est. Cost (\$)
1	2500	24	245.64	X-52	Plain End	2500	2500	21.6	164993

Run Seq	Collapse Load (psi)	Collapse Strength (psi)	Collapse Design Factor	Burst Load (psi)	Burst Strength (psi)	Burst Design Factor	Tension Load (kips)	Tension Strength (kips)	Tension Design Factor
1	1325	2430	1.834	1588	3790	2.39	614.1	3757.3	6.12 B

Prepared Helen Sadik-Macdonald  
by: Div of Oil, Gas & Mining

Phone: 801 538-5357  
FAX: 801-359-3940

Date: February 29, 2012  
Salt Lake City, Utah

**Remarks:**

Collapse is based on a vertical depth of 2500 ft, a mud weight of 10.2 ppg. The casing is considered to be evacuated for collapse purposes. Collapse strength is based on the Westcott, Dunlop & Kemler method of biaxial correction for tension.

Burst strength is not adjusted for tension.

Well name:	<b>43027500020000 CW-5</b>	
Operator:	<b>Magnum Solution Mining, LLC</b>	
String type:	Intermediate: Prod'n	Project ID: 43-027-50002
Location:	MILLARD COUNTY	

**Design parameters:****Collapse**

Mud weight: 10.200 ppg  
Design is based on evacuated pipe.

**Minimum design factors:****Collapse:**

Design factor 1.125

**Burst:**

Design factor 1.00

**Environment:**

H2S considered? No  
Surface temperature: 74 °F  
Bottom hole temperature: 121 °F  
Temperature gradient: 1.40 °F/100ft  
Minimum section length: 1,000 ft

Cement top: 1,522 ft

**Burst**

Max anticipated surface pressure: 1,105 psi  
Internal gradient: 0.220 psi/ft  
Calculated BHP 1,842 psi

No backup mud specified.

**Tension:**

8 Round STC: 1.80 (J)  
8 Round LTC: 1.80 (J)  
Buttress: 1.60 (J)  
Premium: 1.50 (J)  
Body yield: 1.60 (B)

Tension is based on air weight.  
Neutral point: 2,894 ft

**Non-directional string.****Production liner info:**

Liner setting depth: 3,450 ft  
Pore pressure equivalent: 10,400 ppg  
Assumed BHP at TD: 1,864 psi

Estimated cost: 180,675 (\$)

Run Seq	Segment Length (ft)	Size (in)	Nominal Weight (lbs/ft)	Grade	End Finish	True Vert Depth (ft)	Measured Depth (ft)	Drift Diameter (in)	Est. Cost (\$)
2	1800	20	133.00	N-80	Buttress	1800	1800	18.542	86273
1	1550	20	169.00	N-80	Buttress	3350	3350	18.188	94402

Run Seq	Collapse Load (psi)	Collapse Strength (psi)	Collapse Design Factor	Burst Load (psi)	Burst Strength (psi)	Burst Design Factor	Tension Load (kips)	Tension Strength (kips)	Tension Design Factor
2	954	1560	1.636	1501	4450	2.96	501.4	2877	5.74 J
1	1775	3020	1.701	1842	4920	2.67	262	3645	13.91 J

Prepared by: Helen Sadik-Macdonald  
Div of Oil, Gas & Mining

Phone: 801 538-5357  
FAX: 801-359-3940

Date: January 25, 2012  
Salt Lake City, Utah

**Remarks:**

Collapse is based on a vertical depth of 3350 ft, a mud weight of 10.2 ppg. The casing is considered to be evacuated for collapse purposes. Collapse strength is based on the Westcott, Dunlop & Kemler method of biaxial correction for tension.

Burst strength is not adjusted for tension.

Well name:	<b>43027500020000 CW-5</b>	
Operator:	<b>Magnum Solution Mining, LLC</b>	Project ID:
String type:	Production	43-027-50002
Location:	MILLARD COUNTY	

**Design parameters:****Collapse**

Mud weight: 10.400 ppg  
Design is based on evacuated pipe.

**Minimum design factors:****Collapse:**

Design factor 1.125

**Burst:**

Design factor 1.00

**Environment:**

H2S considered? No  
Surface temperature: 74 °F  
Bottom hole temperature: 122 °F  
Temperature gradient: 1.40 °F/100ft  
Minimum section length: 100 ft

Cement top: 1,210 ft

**Burst**

Max anticipated surface pressure: 1,105 psi  
Internal gradient: 0.220 psi/ft  
Calculated BHP 1,864 psi

No backup mud specified.

**Tension:**

8 Round STC: 1.80 (J)  
8 Round LTC: 1.80 (J)  
Buttress: 1.60 (J)  
Premium: 1.50 (J)  
Body yield: 1.60 (B)

**Non-directional string.**

Tension is based on air weight.  
Neutral point: 2,971 ft

Estimated cost: 137,513 (\$)

Run Seq	Segment Length (ft)	Size (in)	Nominal Weight (lbs/ft)	Grade	End Finish	True Vert Depth (ft)	Measured Depth (ft)	Drift Diameter (in)	Est. Cost (\$)
2	2000	16	95.00	N-80	Buttress	2000	2000	14.75	68666
1	1450	16	118.00	L-80	Big Omega	3450	3450	14.341	68847

Run Seq	Collapse Load (psi)	Collapse Strength (psi)	Collapse Design Factor	Burst Load (psi)	Burst Strength (psi)	Burst Design Factor	Tension Load (kips)	Tension Strength (kips)	Tension Design Factor
2	1081	2130	1.972	1545	4950	3.20	361.1	2161	5.98 J
1	1864	3680	1.974	1864	6260	3.36	171.1	2650	15.49 J

Prepared by: Helen Sadik-Macdonald  
Div of Oil, Gas & Mining

Phone: 801 538-5357  
FAX: 801-359-3940

Date: January 24, 2012  
Salt Lake City, Utah

**Remarks:**

Collapse is based on a vertical depth of 3450 ft, a mud weight of 10.4 ppg. The casing is considered to be evacuated for collapse purposes. Collapse strength is based on the Westcott, Dunlop & Kemler method of biaxial correction for tension.

Burst strength is not adjusted for tension.



Diana Mason &lt;dianawhitney@utah.gov&gt;

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## Magnum CW-5 and CW-6 Approval

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**Jim Davis** <jimdavis1@utah.gov>

Thu, May 2, 2013 at 12:08 PM

To: Brad Hill &lt;BRADHILL@utah.gov&gt;, Diana Mason &lt;dianawhitney@utah.gov&gt;, Ted Smith &lt;TEDSMITH@utah.gov&gt;

Cc: Lavonne Garrison &lt;LAVONNEGARRISON@utah.gov&gt;, Tiffany James &lt;tiffanyjames@westernenergyhub.com&gt;, "Quigley, Sam" &lt;squigley@westernenergyhub.com&gt;, Ed Bonner &lt;EDBONNER@utah.gov&gt;, Jeff Conley &lt;jconley@utah.gov&gt;

Please accept this email as SITLA's approval of the proposed Magnum wells CW-5 ([4302750002](#)) and CW-6 ([4302750003](#)).

There is an arch site adjacent to the CW-5 well's area (Site number 42Md3310). Magnum has committed to fence the site, avoid it and to have an arch monitor on-site during ground-disturbing activities.

SITLA has received bonds from Magnum to cover CW-5, CW-6, the brine ponds and other interim reclamation within the lease area.

This is all well and satisfactory to SITLA. Thanks.

-Jim

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[jimdavis1@utah.gov](mailto:jimdavis1@utah.gov)  
(801) 538-5156

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**ON-SITE PREDRILL EVALUATION****Utah Division of Oil, Gas and Mining**

**Operator** MAGNUM SOLUTION MINING, LLC  
**Well Name** CW-5  
**API Number** 43027500020000      **APD No** 4838      **Field/Unit** UNDESIGNATED  
**Location:**  
**1/4, 1/4** SWSW      **Sec** 23      **Tw** 15.0S      **Rng** 7.0W      147 FSL 167 FWL  
**GPS Coord**  
**(UTM)** 361435 4372916      **Surface Owner**

**Participants**

Ted Smith, Ammon McDonald-DOGM, Sam Quigley, David Babcock-Magnum

**Regional/Local Setting & Topography**

Sevier Desert valley with a few cultivated hay fields and grazing land. This valley sits between the Canyon Mountains and Sevier River to the east and the Drum Mountains to the west. Surrounding area is dry grazing land with a few cultivated fields needing water continuously. The Intermountain Power Plant is 0.75 miles to the northeast. Area of proposed pad basically flat and dry with a 3-5 foot drop on the west side of the proposed pad. Proposed location is approximately 10 miles north of the town of Delta. Altitude at site approximately 4612'-4616'.

**Surface Use Plan****Current Surface Use**

Grazing  
Wildlife Habitat

**New Road  
Miles**

0.07

**Well Pad**

**Width** 300      **Length** 290

**Src Const Material**

Onsite

**Surface Formation**

ALLU

**Ancillary Facilities** N

None with exception of trailers to be on location during drilling operations. Future operation plans for 3 more wells being drilled close to proposed well. Operations facility will be built at a later date along with dehydration compression facility.

**Waste Management Plan Adequate?** Y**Environmental Parameters****Affected Floodplains and/or Wetlands** N**Flora / Fauna**

Flora around the drill location area consist of - Greasewood, salt brush and Winter Fat.

Fauna around the drill location area consist of - Coyote, Cattle, and Rabbit.

**Soil Type and Characteristics**

Alluvium valley fill with soil crusts on surface such as mosses and lichens

**Erosion Issues** N



**Sedimentation Issues** N**Site Stability Issues** N**Drainage Diversion Required?** N**Berm Required?** N**Erosion Sedimentation Control Required?** N**Paleo Survey Run?** N **Paleo Potential Observed?** N **Cultural Survey Run?** Y **Cultural Resources?** N**Reserve Pit****Site-Specific Factors****Site Ranking****Distance to Groundwater (feet)** 25 to 75 15**Distance to Surface Water (feet)** 300 to 1000 2**Dist. Nearest Municipal Well (ft)** 1320 to 5280 5**Distance to Other Wells (feet)** 20**Native Soil Type** Mod permeability 10**Fluid Type** Fresh Water 5**Drill Cuttings** Salt or Detrimental 10**Annual Precipitation (inches)** 0**Affected Populations****Presence Nearby Utility Conduits****Final Score** 67 3 Sensitivity Level**Characteristics / Requirements**

Reserve pit will be constructed so as not to leak, break, or discharge. The reserve pit will be lined with minimum of 20 mil plastic liner with felt placed between the ground and liner as a request from SITLA.

Pit will be 100' x 150' x 12' in size. The reserve pit will be fenced once it has been lined.

The pit location is approximately 100 feet northeast of Magnum Solutions water well.

There is a USGS section corner marker located on the southern end of the proposed reserve pit. This marker will need to be moved according to USGS regulations before the reserve pit is constructed.

**Closed Loop Mud Required?** N **Liner Required?** Y **Liner Thickness** 20 **Pit Underlayment Required?** Y**Other Observations / Comments**

Magnum Solutions Mining, LLC. will use a open lined pit program. All pit fluids will be hauled to an approved disposal site for waste management once well is completed. Fresh water source will be from Magnum's MH-1 well located 100 feet west of location. Access road will be using State HWY # 174 to Millard County Road called the Jones Road then continues on through landowners ( SITLA) property for 0.07 mile on to new access road to API #4302750002. Millard county has issued Magnum a conditional use permit for use of their road. There are two large over head power lines located south of State HWY 174 and 0.5 miles to the north of proposed location. One power line is 230 mega watt AC current and one power line is 500 mega watt DC.

The Intermountain Power Project 1900 mega watt power plant is located north of State HWY 174 and approximately 0.75 mile north of proposed location. There is two occupied houses 0.75 northeast of location. There are 9 water wells within 1 mile of location. The closest being Magnum's MH-1 well at 100 feet The Sevier River is located approximately 10 miles east from proposed location. There is one PA well API 4302730012 within one mile of proposed well. The operator Magnum Solutions Mining, LLC having leased the property from SITLA using lease #51573-OBA. There currently is one grazing lease issued by SITLA for this area. SITLA personnel were invited to attend preiste but elected not to attend. There is no local disagreement by local landowners with this drilling program. Rig lights and noise may be seen and herd in the town of Delta 10 miles south of location. Photos are located in well file.

Ted Smith  
**Evaluator**

12/13/2011  
**Date / Time**

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# Application for Permit to Drill

## Statement of Basis

### Utah Division of Oil, Gas and Mining

APD No	API WellNo	Status	Well Type	Surf Owner	CBM
4838	43027500020000	LOCKED	GS	S	No
Operator	MAGNUM SOLUTION MINING, LLC		Surface Owner-APD		
Well Name	CW-5		Unit		
Field	UNDESIGNATED		Type of Work	DRILL	
Location	SWSW 23 15S 7W S 147 FSL (UTM)	361436E 4372922N	167 FWL GPS Coord		

#### Geologic Statement of Basis

The proposed well location is in western Utah within the Basin and Range physiographic province. The mountains that bound the valley are composed of various sedimentary, metamorphic, and igneous rocks and the valley-fill is composed of sands, silts, and gravels. These Tertiary and Quaternary aged valley deposits are over 7,000' thick. Oligocene and Miocene evaporite deposits have flowed over time to form a large salt dome, which is the drilling target.

Magnum has proposed 150' of conductor pipe, 750' of surface casing and a 2,500' intermediate casing for this well. The holes for all three strings will be drilled with fresh water mud and will be cemented back to the ground surface. A search of the Division of Water Rights database indicates that there are over 25 water wells within a 10,000' radius of the proposed location. These wells range in depth from 55' to 940'. Most of these wells are used for source water for Magnum's project and the Intermountain Power Plant. Four wells near the outside of the radius and directly south are used for a combination of irrigation, stock watering and irrigation. Magnum drilled several test wells during the initial phase of this project. These wells provided data to define the ground water quality at depth for the proposed well. This data indicates that ground water quality begins to diminish below 2,500' and becomes saline near 3,000'. The proposed casing and cement program should adequately protect usable ground water in this area.

Ammon McDonald  
APD Evaluator

1/18/2012  
Date / Time

#### Surface Statement of Basis

A presite was conducted at 10:00 am December 13, 2011. This area is easily accessed off State Highway 174. Operator will be required to construct a access road 0.07 mile onto property they have leased from SITLA. There is a USGS section corner marker located on the southern end of the reserve pit. This marker will need to be moved according to USGS regulations before the reserve pit is constructed.

The proposed CW-5 pad runs north to south direction and is located in the Sevier Desert valley . The construction material needed for this location and access road will be obtained from a local Delta gravel pit. The pad is located on a slight slope to the west. The reserve pit will be located 100' northeast of Magnum Solutions water well.

The landowner SITLA has requested that the reserve pit be lined with a 20 ml thick liner and a subliner placed between the ground and liner..

The selected location for this well is suitable for drilling.

Ted Smith  
**Onsite Evaluator**

12/13/2011  
**Date / Time**

**Conditions of Approval / Application for Permit to Drill**

<b>Category</b>	<b>Condition</b>
Pits	A synthetic liner with a minimum thickness of 20 mils with a felt subliner shall be properly installed and maintained in the reserve pit.
Surface	The reserve pit shall be fenced upon completion of drilling operations.

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## WORKSHEET APPLICATION FOR PERMIT TO DRILL

APD RECEIVED: 11/3/2011

API NO. ASSIGNED: 43027500020000

WELL NAME: CW-5

OPERATOR: MAGNUM SOLUTION MINING, LLC (N3995)

PHONE NUMBER: 801 993-7001

CONTACT: Tiffany A. James

PROPOSED LOCATION: SWSW 23 150S 070W

Permit Tech Review: ☒

SURFACE: 0147 FSL 0167 FWL

Engineering Review: ☒

BOTTOM: 0147 FSL 0167 FWL

Geology Review: ☒

COUNTY: MILLARD

LATITUDE: 39.49475

LONGITUDE: -112.61144

UTM SURF EASTINGS: 361436.00

NORTHINGS: 4372922.00

FIELD NAME: UNDESIGNATED

LEASE TYPE: 3 - State

LEASE NUMBER: 51573-OBA

PROPOSED PRODUCING FORMATION(S): SALT

SURFACE OWNER: 3 - State

COALBED METHANE: NO

## RECEIVED AND/OR REVIEWED:

☒ PLAT☒ Bond: STATE/FEE - B008001☐ Potash☐ Oil Shale 190-5☐ Oil Shale 190-3☐ Oil Shale 190-13☒ Water Permit: 68-396☒ RDCC Review: 2013-05-02 00:00:00.0☐ Fee Surface Agreement☐ Intent to Commingle

Commingle Approved

## LOCATION AND SITING:

☐ R649-2-3.

Unit:

☐ R649-3-2. General☒ R649-3-3. Exception☒ Drilling Unit

Board Cause No: R649-3-3

Effective Date:

Siting:

☐ R649-3-11. Directional DrillComments: Presite Completed  
OP NM FR N3715Stipulations: 1 - Exception Location - dmason  
5 - Statement of Basis - bhill  
9 - Cement casing to Surface - ddoucet  
21 - RDCC - dmason

RECEIVED: May 02, 2013



GARY R. HERBERT  
*Governor*

GREGORY S. BELL  
*Lieutenant Governor*

# State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER  
*Executive Director*

Division of Oil, Gas and Mining

JOHN R. BAZA  
*Division Director*

## Permit To Drill

\*\*\*\*\*

**Well Name:** CW-5

**API Well Number:** 43027500020000

**Lease Number:** 51573-OBA

**Surface Owner:** STATE

**Approval Date:** 5/2/2013

### Issued to:

MAGNUM SOLUTION MINING, LLC, 3165 E Millrock Dr, Holladay, UT 84124

### Authority:

Pursuant to Utah Code Ann. 40-6-1 et seq., and Utah Administrative Code R649-3-1 et seq., the Utah Division of Oil, Gas and Mining issues conditions of approval, and permit to drill the listed well. This permit is issued in accordance with the requirements of R649-3-3. The expected producing formation or pool is the SALT Formation(s), completion into any other zones will require filing a Sundry Notice (Form 9). Completion and commingling of more than one pool will require approval in accordance with R649-3-22.

### Duration:

This approval shall expire one year from the above date unless substantial and continuous operation is underway, or a request for extension is made prior to the expiration date

### Exception Location:

Appropriate information has been submitted to DOGM and administrative approval of the requested exception location is hereby granted.

### General:

Compliance with the requirements of Utah Admin. R. 649-1 et seq., the Oil and Gas Conservation General Rules, and the applicable terms and provisions of the approved Application for permit to drill.

### Conditions of Approval:

The Application for Permit to Drill has been forwarded to the Resource Development Coordinating Committee for review of this action. The operator will be required to comply with any applicable recommendations resulting from this review. (See attached)

Compliance with the Conditions of Approval/Application for Permit to Drill outlined in the Statement of Basis (copy attached).

The cement volumes for the 30", and 24" casing strings shall be determined from actual hole conditions and the setting depths of the casings in order to place cement from the pipe setting depths back to the surface as indicated in submitted



drilling plan.

**Additional Approvals:**

The operator is required to obtain approval from the Division of Oil, Gas and mining before performing any of the following actions during the drilling of this well:

- Any changes to the approved drilling plan - contact Dustin Doucet
- Significant plug back of the well - contact Dustin Doucet
- Plug and abandonment of the well - contact Dustin Doucet

**Notification Requirements:**

The operator is required to notify the Division of Oil, Gas and Mining of the following actions during drilling of this well:

- Within 24 hours following the spudding of the well - contact Carol Daniels  
OR  
submit an electronic sundry notice (pre-registration required) via the Utah Oil & Gas website  
at <http://oilgas.ogm.utah.gov>
- 24 hours prior to testing blowout prevention equipment - contact Dan Jarvis
- 24 hours prior to cementing or testing casing - contact Dan Jarvis
- Within 24 hours of making any emergency changes to the approved drilling program  
- contact Dustin Doucet
- 24 hours prior to commencing operations to plug and abandon the well - contact Dan Jarvis

**Contact Information:**

The following are Division of Oil, Gas and Mining contacts and their telephone numbers (please leave a voicemail message if the person is not available to take the call):

- Carol Daniels 801-538-5284 - office
- Dustin Doucet 801-538-5281 - office  
801-733-0983 - after office hours
- Dan Jarvis 801-538-5338 - office  
801-231-8956 - after office hours

**Reporting Requirements:**

All reports, forms and submittals as required by the Utah Oil and Gas Conservation General Rules will be promptly filed with the Division of Oil, Gas and Mining, including but not limited to:

- Entity Action Form (Form 6) - due within 5 days of spudding the well
- Monthly Status Report (Form 9) - due by 5th day of the following calendar month
- Requests to Change Plans (Form 9) - due prior to implementation
- Written Notice of Emergency Changes (Form 9) - due within 5 days
- Notice of Operations Suspension or Resumption (Form 9) - due prior to implementation
- Report of Water Encountered (Form 7) - due within 30 days after completion
- Well Completion Report (Form 8) - due within 30 days after completion or plugging

**Approved By:**

A handwritten signature in black ink, appearing to read "J. Rogers", written over a horizontal line.

For John Rogers  
Associate Director, Oil & Gas

CONFIDENTIAL

## DIVISION OF OIL, GAS AND MINING

### SPUDDING INFORMATION

Name of Company; MAGNUM NGLS SOLUTION MINING LLC

Well Name: CW-5

Api No: 43-027-50002 Lease Type STATE

Section 23 Township 15S Range 07W County MILLARD

Drilling Contractor \_\_\_\_\_ RIG # \_\_\_\_\_

### SPUDDED:

Date 05/15/2013

Time \_\_\_\_\_

How DRY

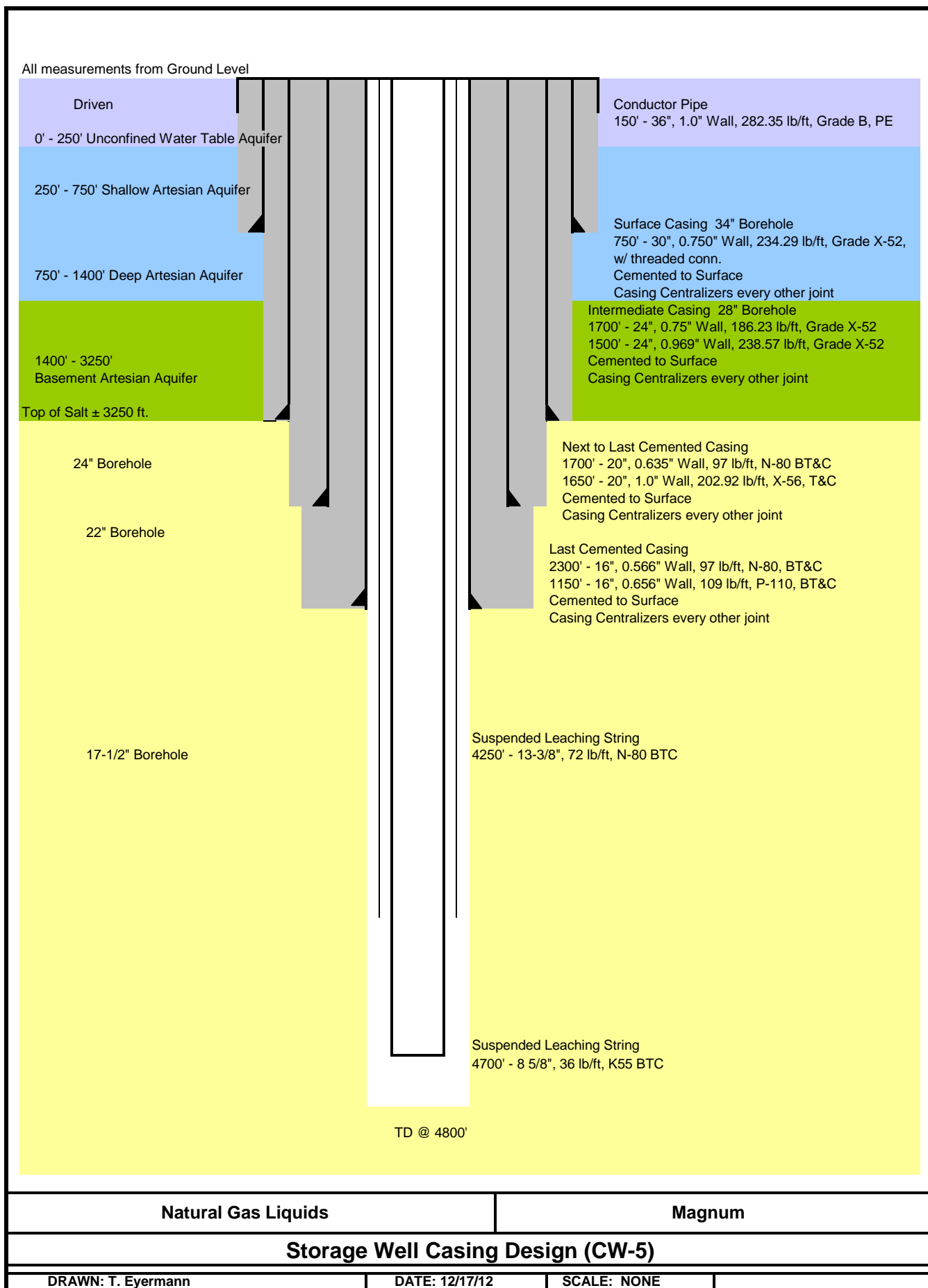
**Drilling will Commence:** \_\_\_\_\_

Reported by TELEPHONE CALL TO BRAD HILL

Telephone # \_\_\_\_\_

Date 05/15/2013 Signed CHD

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>  
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>  
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input checked="" type="checkbox"/> <b>NOTICE OF INTENT</b> Approximate date work will start: 6/1/2013  <input type="checkbox"/> <b>SUBSEQUENT REPORT</b> Date of Work Completion:  <input type="checkbox"/> <b>SPUD REPORT</b> Date of Spud:  <input type="checkbox"/> <b>DRILLING REPORT</b> Report Date:	<div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;"> <input type="checkbox"/> ACIDIZE  <input checked="" type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION         </div> <div style="width: 33%;"> <input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION  <input type="checkbox"/> OTHER         </div> <div style="width: 33%;"> <input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION         </div> </div>	
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. Magnum is requesting a minor modification of the Cavern Well 5 (CW-5) casing design specific only to the 24-inch casing. The original 24-inch casing design includes 1800 ft of 24-inch casing with a 1.0-inch wall thickness at 245.64 lbs/ft, grade X-52; and 1400 ft of 24-inch casing with a 1.25-inch wall thickness at 303.71 lbs/ft, grade X-52, cemented to the surface. The requested revised engineering design includes 1700 ft of 24-inch casing with a 0.75-inch wall thickness at 186.23 lbs/ft, grade X-52; and 1500 ft of 24-inch casing with a 0.969-inch wall thickness at 238.57 lbs/ft, grade X-52, cemented to the surface. The attached revised schematic for CW-5 shows the modified design for the 24-inch casing.		
<b>NAME (PLEASE PRINT)</b> Tiffany A. James		<b>PHONE NUMBER</b> 801 993-7001
<b>SIGNATURE</b> N/A		<b>TITLE</b> Vice President Project Development
<b>DATE</b> 5/22/2013		<b>APPROVED BY:</b> <div style="text-align: right;"> <b>Approved by the Utah Division of Oil, Gas and Mining</b>   <b>Date:</b> May 23, 2013  <b>By:</b> <u>Derek Duff</u> </div>



**STATE OF UTAH**  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

**RECEIVED**

FORM 6

**MAY 20 2013**

DIV. OF OIL, GAS &amp; MINING

**ENTITY ACTION FORM**

Operator: Magnum NGLs Solution Mining, LLC  
Address: 3165 E. Millrock Drive  
city Holladay  
state UT zip 84124

Operator Account Number: N 3995Phone Number: (801) 993-7001**Well 1**

API Number	Well Name		QQ	Sec	Twp	Rng	County
4302750002	CW-5		SWSW	23	15S	7W	Millard
Action Code	Current Entity Number	New Entity Number	Spud Date			Entity Assignment Effective Date	
A	19046	19046	5/15/2013			5/15/2013	
<b>Comments:</b> API Number: 43027500020000 Spud Time/Date: 23:00 Hours/15 May 2013							

**Well 2**

API Number	Well Name		QQ	Sec	Twp	Rng	County
Action Code	Current Entity Number	New Entity Number	Spud Date			Entity Assignment Effective Date	
<b>Comments:</b>							

**Well 3**

API Number	Well Name		QQ	Sec	Twp	Rng	County
Action Code	Current Entity Number	New Entity Number	Spud Date			Entity Assignment Effective Date	
<b>Comments:</b>							

**ACTION CODES:**

- A - Establish new entity for new well (single well only)
- B - Add new well to existing entity (group or unit well)
- C - Re-assign well from one existing entity to another existing entity
- D - Re-assign well from one existing entity to a new entity
- E - Other (Explain in 'comments' section)

Tiffany James

Name (Please Print)

Signature

VP Project Development

Title

5/20/2013

Date



<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 6/5/2013	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION <input checked="" type="checkbox"/> OTHER	
<input type="checkbox"/> SPUD REPORT Date of Spud:	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION	
<input type="checkbox"/> DRILLING REPORT Report Date:	OTHER: <input type="text" value="Monthly Status Report"/>	
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. Monthly Status Report for May, 2013: 15 May - Well spudded 15-17 May - 44-inch diameter borehole drilled to 151 feet b.g.s. 17-18 May - 36" diameter surface casing installed to 148.9 feet b.g.s. and cemented. 20-29 May - 17.5-inch diameter pilot hole and 34-inch diameter borehole drilled to 771.9 feet b.g.s. 30-31 May - 30-inch diameter casing installed to 766.9 feet b.g.s.; to be cemented All casing and cement installed in accordance with project specifications.		
Accepted by the Utah Division of Oil, Gas and Mining <b>FOR RECORD ONLY</b> June 06, 2013		
<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 6/5/2013	

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OB A
		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>1. TYPE OF WELL</b> Gas Storage Well	<b>8. WELL NAME and NUMBER:</b> CW-5	
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC	<b>9. API NUMBER:</b> 43027500020000	
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	<b>PHONE NUMBER:</b> 801 993-7001 Ext	<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>COUNTY:</b> MILLARD
		<b>STATE:</b> UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION			
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input checked="" type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION <input type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION	OTHER: <input style="width: 100px;" type="text"/>
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: <b>5/2/2013</b>				
<input type="checkbox"/> SPUD REPORT Date of Spud:				
<input type="checkbox"/> DRILLING REPORT Report Date:				

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Well pad design changed to meet drilling contractor's typical design criteria and surface layout. See attached plan and cross sections.

**Approved by the  
Utah Division of  
Oil, Gas and Mining**

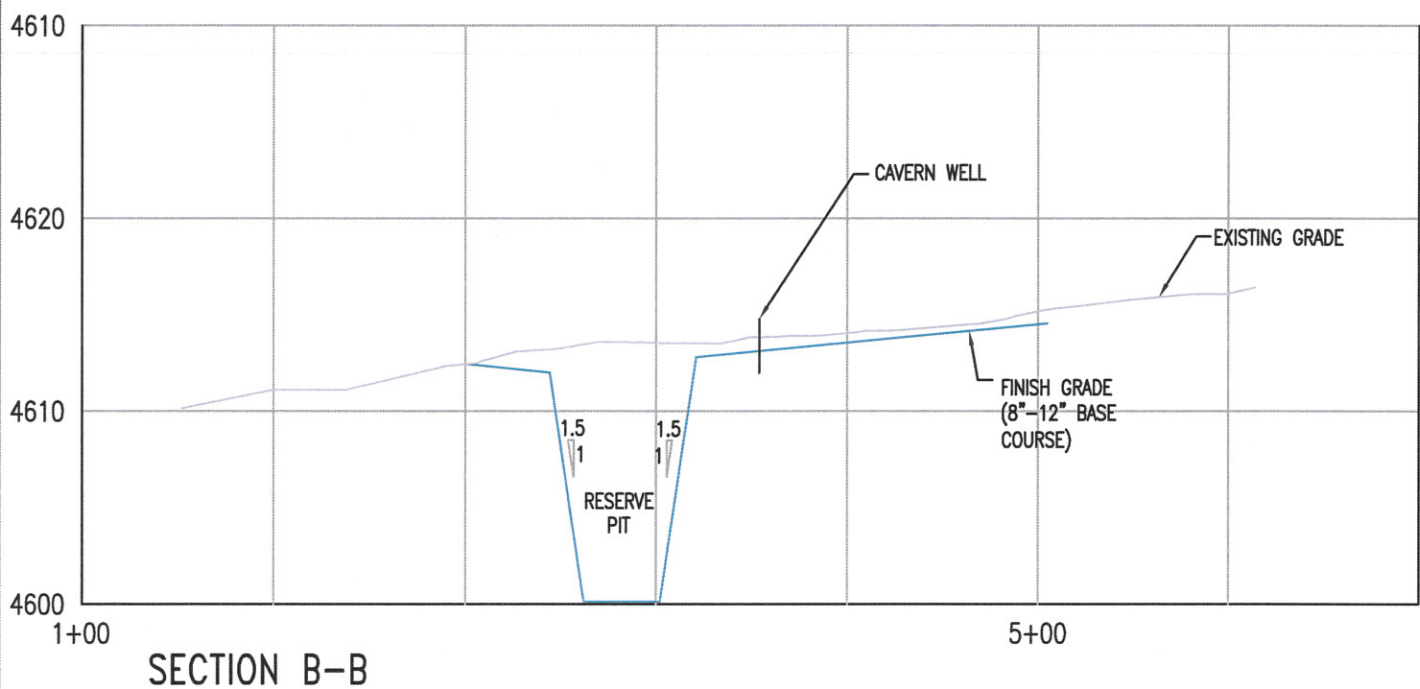
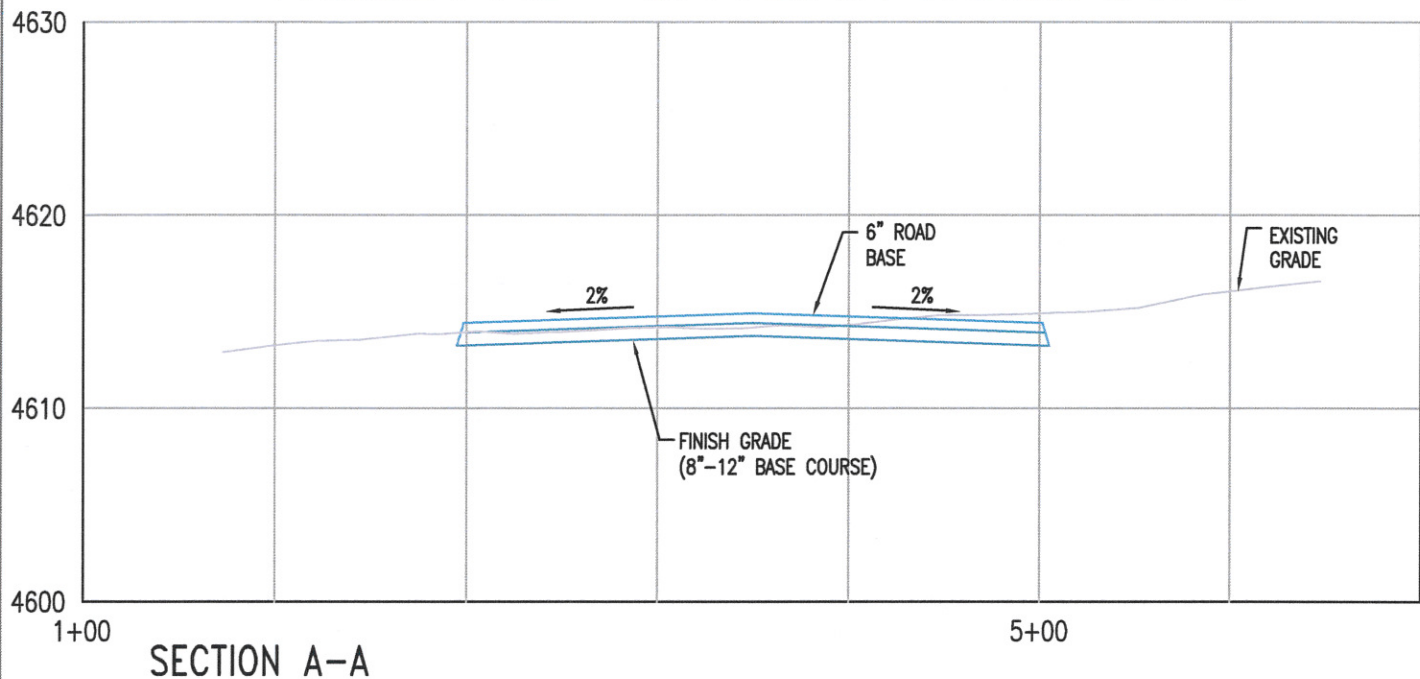
**Date:** June 12, 2013

**By:** 

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 5/23/2013	

(Revised 5/3/13)

# WELL PAD - CAVERN WELL CW-5



## NOTES:

1. WELL FOOTAGES ARE MEASURED AT RIGHT ANGLES TO THE SECTION LINES.
2. BASIS OF ELEVATION IS MAGNUM CONTROL POINT MAG-CP-02.
3. RESERVE PIT TO BE LINED WITH 20 MIL HDPE LINER.

POINT NO.	NORTHING	EASTING	ELEVATION
MAG-CP-02	205,008.897	501,554.063	4,628.50
	LATITUDE	LONGITUDE	E.I. HGT.
	N39°29'37.6436"	W112°36'23.7187"	4,565.10

## SCALE:

VERTICAL 1"=10'  
HORIZONTAL 1"=100'



3165 E. MILLROCK DR, SUITE 330  
HOLLADAY, UTAH 84121  
PHONE: (801) 993-7001

DATE: 05/16/2013 SURVEYED BY: SUNRSIE  
DATE DRAWN: 05/16/2013 DRAWN BY: LMR  
SCALE: 1"=100' REVISED: TJ

SHEET NO:  
**CW-5**



Division of Oil, Gas and Mining  
**OPERATOR CHANGE WORKSHEET (for state use only)**

**ROUTING**  
**CDW**

**X - Change of Operator (Well Sold)**

Operator Name Change/Merger

The operator of the well(s) listed below has changed, effective:

**5/6/2013**

**FROM: (Old Operator):**

N3715- Magnum Solution Mining, LLC  
 3165 E Millrock Dr  
 Holladay, UT, 84124

Phone: 1 (801) 993-7001

**TO: ( New Operator):**

N3995- Magnum NGLs Solutions Mining, LLC  
 3165 E. Millrock Dr, Suite 330  
 Holladay, UT, 84121

Phone: 1 (801) 993-7001

**CA No.**

**Unit:**

WELL NAME	SEC	TWN	RNG	API NO	ENTITY NO	LEASE TYPE	WELL TYPE	WELL STATUS
CW-5	23	150S	070W	4302750002	19046	State	GS	DRL
CW-6	26	150S	070W	4302750003		State	GS	APD

**OPERATOR CHANGES DOCUMENTATION**

Enter date after each listed item is completed

- (R649-8-10) Sundry or legal documentation was received from the **FORMER** operator on: 5/28/2013
- (R649-8-10) Sundry or legal documentation was received from the **NEW** operator on: 5/28/2013
- The new company was checked on the **Department of Commerce, Division of Corporations Database** on: 6/12/2013
- a. Is the new operator registered in the State of Utah: Business Number: 8615504-0160
- 5a. (R649-9-2) Waste Management Plan has been received on: Not Yet
- 5b. Inspections of LA PA state/fee well sites complete on: N/A
- 5c. Reports current for Production/Disposition & Sundries on: N/A
- Federal and Indian Lease Wells:** The BLM and or the BIA has approved the merger, name change, or operator change for all wells listed on Federal or Indian leases on: BLM N/A BIA N/A
- Federal and Indian Units:**  
The BLM or BIA has approved the successor of unit operator for wells listed on: N/A
- Federal and Indian Communization Agreements ("CA"):**  
The BLM or BIA has approved the operator for all wells listed within a CA on: N/A
- Underground Injection Control ("UIC")** Division has approved UIC Form 5 Transfer of Authority to **Inject**, for the enhanced/secondary recovery unit/project for the water disposal well(s) listed on: N/A

**DATA ENTRY:**

- Changes entered in the **Oil and Gas Database** on: 6/12/2013
- Changes have been entered on the **Monthly Operator Change Spread Sheet** on: 6/12/2013
- Bond information entered in RBDMS on: 5/3/2013
- Fee/State wells attached to bond in RBDMS on: 5/3/2013
- Injection Projects to new operator in RBDMS on: N/A
- Receipt of Acceptance of Drilling Procedures for APD/New on: 6/12/2013

**BOND VERIFICATION:**

- Federal well(s) covered by Bond Number: N/A
- Indian well(s) covered by Bond Number: N/A
- 3a. (R649-3-1) The **NEW** operator of any state/fee well(s) listed covered by Bond Number see Comments
- 3b. The **FORMER** operator has requested a release of liability from their bond on: N/A

**LEASE INTEREST OWNER NOTIFICATION:**

- (R649-2-10) The **NEW** operator of the fee wells has been contacted and informed by a letter from the Division of their responsibility to notify all interest owners of this change on: N/A

**COMMENTS:**

4302750002 CW-5, bond number B008001  
 4302750003 CW-6, bond number B008000

# APPROVED

JUN 12 2013

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

FORM 5

DIV. OIL GAS & MINING

BY: Zeke Clement For

## DESIGNATION OF AGENT OR OPERATOR

Rachel Medina

The undersigned is, on record, the holder of oil and gas lease

LEASE NAME: Magnum Holdings, LLC

LEASE NUMBER: 51573-OBA

RECEIVED  
MAY 28 2013

DIV OF OIL GAS & MINING

and hereby designates

NAME: Magnum NGLs Solution Mining, LLC

N3995

ADDRESS: 3165 East Millrock Drive, Suite 330

city Holladay

state UT

zip 84121

as his (check one) agent ☐ / operator ☒, with full authority to act in his behalf in complying with the terms of the lease and regulations applicable thereto and on whom the Division Director or Authorized Agent may serve written or oral instructions in securing compliance with the Oil and Gas Conservation General Rules and Procedural Rules of the Board of Oil, Gas and Mining of the State of Utah with respect to:

(Describe acreage to which this designation is applicable. Identify each oil and gas well by API number and name. Attach additional pages as needed.)

This designation is applicable to the drilling and operation of APD No. 4838 and APD No. 4849 and within the area described as follows: Beginning at the Northwest corner of Section 26, Township 15 South, Range 7 West, Salt Lake Meridian; thence North 89°49'12" West 317.56 feet along section line; thence North 00° 47' 08" West 83.32 feet; thence North 89° 12' 52" East 186.88 feet; thence North 00° 47' 08" West 937.71 feet; thence South 49° 28' 21" East 196.67 feet to a point on section line; thence continuing South 49° 28' 21" East 1393.33 feet to a point on section line; thence continuing South 49° 28' 21" East 948.07 feet; thence South 00° 59' 16" East 300.00 feet; thence South 89° 00' 44" West 1799.61 feet to a point on section line; thence North 00° 34' 52" East 955.81 feet along section line to the POINT OF BEGINNING. Contains 2,077,386 square feet or 47.690 acres, more or less.

It is understood that this designation of agent/operator does not relieve the lessee of responsibility for compliance with the terms of the lease and the Oil and Gas Conservation General Rules and Procedural Rules of the Board of Oil, Gas and Mining of the State of Utah. It is also understood that this designation of agent or operator does not constitute an assignment of any interest in the lease.

In case of default on the part of the designated agent/operator, the lessee will make full and prompt compliance with all rules, lease terms or orders of the Board of Oil, Gas and Mining of the State of Utah or its authorized representative.

The lessee agrees to promptly notify the Division Director or Authorized Agent of any change in this designation.

Effective Date of Designation: 05/06/2013

BY: (Name) Robert Webster

(Signature) [Signature]

(Title) Chief Operating Officer

(Phone) (801) 993-7001

OF: (Company) Magnum Holdings, LLC

(Address) 3165 East Millrock Drive, Suite 330

city Holladay

state UT zip 84121



**APPROVED****JUN 12 2013****DIV. OIL GAS & MINING**BY: Zeke Christ For**STATE OF UTAH**  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING**RECEIVED****JUN 12 2013**Rachel Meding**Request to Transfer Application or Permit to Drill***Div. of Oil, Gas & Mining*

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

Well name:	CW-5
API number:	43027500020000
Location:	Qtr Qtr SWSW Section 23 Township 15S Range 7W
Company that filed original application:	Magnum Solution Mining, LLC <b>N3715</b>
Date original permit was issued:	05/02/2013
Company that permit was issued to:	Magnum Solution Mining, LLC

Check one	Desired Action:
<input type="checkbox"/>	<b>Transfer pending (unapproved) Application for Permit to Drill to new operator</b>
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	<b>Transfer approved Application for Permit to Drill to new operator</b>
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.		Yes	No
If located on private land, has the ownership changed?			<input checked="" type="checkbox"/>
<input type="checkbox"/>	If so, has the surface agreement been updated?		
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?			<input checked="" type="checkbox"/>
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?			<input checked="" type="checkbox"/>
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?			<input checked="" type="checkbox"/>
Has the approved source of water for drilling changed?			<input checked="" type="checkbox"/>
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?			<input checked="" type="checkbox"/>
Is bonding still in place, which covers this proposed well? Bond No <u>B008001</u>			<input checked="" type="checkbox"/>

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Robert WebsterTitle Chief Operating OfficerSignature [Signature]Date 06/11/2013Representing (company name) Magnum Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill.

**APPROVED**

JUN 12 2013

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

**RECEIVED**

JUN 12 2013

DIV. OIL GAS &amp; MINING

BY:

Zeke Clement for**Request to Transfer Application or Permit to Drill**

Div. of Oil, Gas &amp; Mining

Rachel Meding

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

Well name:	CW-6
API number:	43027500030000
Location:	Qtr-Qtr NWNW Section 26 Township 15S Range 7W
Company that filed original application:	Magnum Solution Mining, LLC <b>N 3715</b>
Date original permit was issued:	05/02/2013
Company that permit was issued to:	Magnum Solution Mining, LLC

Check one	Desired Action:
<input type="checkbox"/>	Transfer pending (unapproved) Application for Permit to Drill to new operator
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	Transfer approved Application for Permit to Drill to new operator
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.		Yes	No
If located on private land, has the ownership changed?			<input checked="" type="checkbox"/>
<input type="checkbox"/>	If so, has the surface agreement been updated?		
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?			<input checked="" type="checkbox"/>
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?			<input checked="" type="checkbox"/>
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?			<input checked="" type="checkbox"/>
Has the approved source of water for drilling changed?			<input checked="" type="checkbox"/>
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?			<input checked="" type="checkbox"/>
Is bonding still in place, which covers this proposed well? Bond No. <u>B008000</u>			<input checked="" type="checkbox"/>

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Robert WebsterTitle Chief Operating OfficerSignature [Signature]Date 06/11/2013Representing (company name) Magnum Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill



**MAGNUM**

3165 E. Millrock Dr., #330  
Holladay, Utah 84121  
801-993-7001

www.westernenergyhub.com

RECEIVED

MAY 28 2013

DIV. OF OIL, GAS & MINING

May 23, 2013

Zeke Clements  
Division of Oil, Gas and Mining  
1594 West North Temple, Suite 120  
Salt Lake City, Utah 84114

Mr. Clements,

Enclosed is a Designation of Agent or Operator Form (Form 5) designating Magnum NGLs Solution Mining, LLC as the agent and operator for Well Nos. 43027500020000 and 43027500030000 within an approximately 47.69 acre area (as described in the form). It is Magnum's understanding that these two wells are currently in the Division of Oil, Gas and Mining's files as being operated by Magnum NGLs Solution Mining, LLC although the two permits list Magnum Solution Mining, LLC as the permit holder. As discussed with Rachel Medina, Magnum is submitting this Form 5 to ensure the change is properly documented.

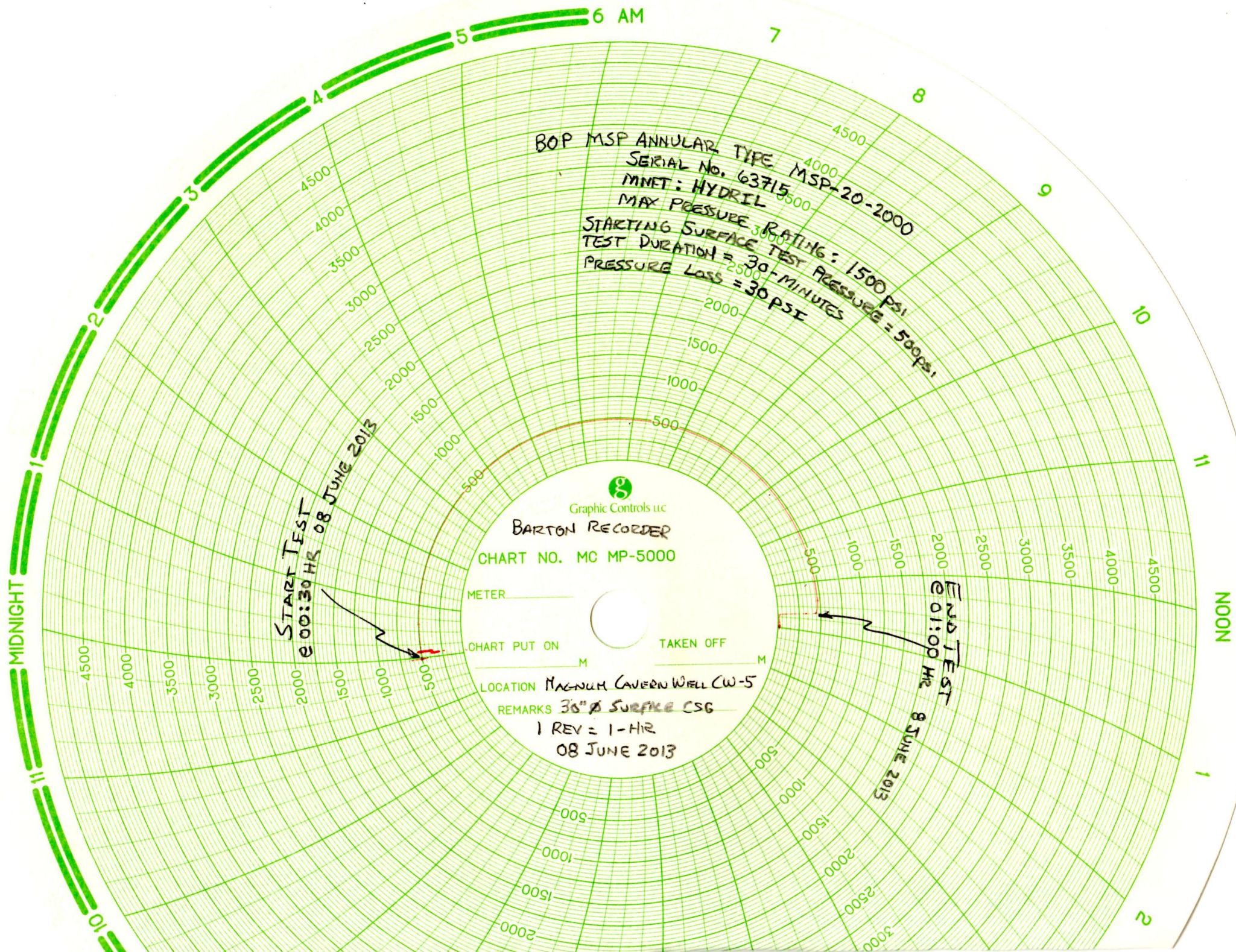
If you have any questions, please feel free to contact me.

Thank you,

Tiffany A. James  
Vice President,  
Project Development  
and Government Affairs  
801.719.9131 cellular  
tjames@westernenergyhub.com

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 6/8/2013	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION <input checked="" type="checkbox"/> OTHER	
<input type="checkbox"/> SPUD REPORT Date of Spud:	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION	
<input type="checkbox"/> DRILLING REPORT Report Date:	OTHER: <span style="border: 1px solid black; padding: 2px;">BOP &amp; 30-in Casing Pressure</span>	
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. <div style="display: flex; justify-content: space-between;"> <div style="width: 70%;"> <p>A Pressure Testing of BOP and 30" diameter Surface Casing String was completed on June, 8 2013. The pressure testing and results were performed in accordance with Project Specifications &amp; DOGM APD Permit Requirements. Specifics of the test include: - Casing specs: 30" x 0.75" Wall Thickness; Bottom of Casing set at 766.9 feet bgs. - BOP Specs: MSP Annular type MSP-20-2000; Manufacturer: Hydril (Serial No. 63715). The duration of the test was 0.5 Hrs with a Starting Surface Test Pressure = 500psi. Pressure loss was 30 psi over duration of test (less that 10 percent). Attached is a digital copy of the Barton Disc that depicts the raw data.</p> </div> <div style="width: 25%; text-align: center;"> <p><b>Accepted by the Utah Division of Oil, Gas and Mining</b></p> <p><b>FOR RECORD ONLY</b></p> <p>June 19, 2013</p> </div> </div>		
<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 6/12/2013	







<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
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		6. IF INDIAN, ALLOTTEE OR TRIBE NAME:
		7. UNIT or CA AGREEMENT NAME:
1. TYPE OF WELL Gas Storage Well	8. WELL NAME and NUMBER: CW-5	
2. NAME OF OPERATOR: MAGNUM NGLS SOLUTION MINING LLC	9. API NUMBER: 43027500020000	
3. ADDRESS OF OPERATOR: 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	PHONE NUMBER: 801 993-7001 Ext	9. FIELD and POOL or WILDCAT: UNDESIGNATED
4. LOCATION OF WELL FOOTAGES AT SURFACE: 0147 FSL 0167 FWL QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S	COUNTY: MILLARD	
		STATE: UTAH

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	<input checked="" type="checkbox"/> OTHER	OTHER: <span style="border: 1px solid black; padding: 2px;">Monthly Status Report-June</span>		

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

(See attached summary of activities)

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 July 08, 2013

NAME (PLEASE PRINT) Tiffany A. James	PHONE NUMBER 801 993-7001	TITLE Vice President Project Development
SIGNATURE N/A		DATE 7/3/2013

Magnum Cavern Well #CW-5 Monthly Status Report for June, 2013:

01-04 June - Cemented 30" diameter x 0.75" wall thickness Grade X56M steel casing for Surface Casing Interval (+10" ags to 766.9 feet bgs).

05-08 June - Prepare, assemble, nipple up & Install BOP. Pressure test BOP/30" diameter casing. Refer to Subsequent Sundry Report #39020 for test results.

08-09 June - Drill out float shoe and cement in bottom of 30" casing from 721' - 775' bgs.

09-30 June - 17.5-inch diameter pilot hole drilled from 775 feet to 2668 feet b.g.s. Borehole deviation surveys conducted at minimum 100' intervals. All inclinations recorded were at or below the 1 degree/100 feet of borehole specification tolerance; with the exception of the last survey conducted the evening of June 30, 2013 at 2540 & 2530' bgs. Inclinations of -1.5 degrees were recorded for both depths. Currently using drop BHA assembly in attempt to plumb hole.

12-20 June - Constructed Additional Reserve Mud Pits #2 & #3. Subsequent Sundry Report to be submitted soon.

All casing and cement installed in accordance with project specifications. Drilling was in direct accordance with project specifications and Utah DOGM Application Permit to Drill requirements.



<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
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<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH

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<input type="checkbox"/> SPUD REPORT Date of Spud:	<input checked="" type="checkbox"/> OTHER			
<input type="checkbox"/> DRILLING REPORT Report Date:	OTHER: <span style="border: 1px solid black; padding: 2px;">Monthly Status Report-July 2</span>			

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.  

See attached monthly report of activities.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 September 10, 2013

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 8/2/2013	

**Magnum Cavern Storage Well #CW-5 – July 2013 Monthly Status Report Summary**

- 01-07 July, 2013:** Trip in 17.5" diameter pilot hole using drop-type BHA/Drill String for 24" diameter Intermediate Casing Interval to 1389' bgs depth. Drawworks feed not functioning properly. Rig Repair downtime to replace and test the two replacement Hagglund brake motors and drawworks functions.
- 08-09 July 2013:** Resume trip from 1389' to 2515', cave/heave materials encountered at 2515' bgs. Clean-out from 2515' to 2668' (former TD before rig repair downtime); then condition mud and borehole and circulate.
- 10-15 July 2013:** Drill/advance 17.5" diameter pilot hole for 24" diameter Intermediate Casing Interval from 2668' to 3260' bgs (TD of 17.5" diameter pilot Hole). Anhydrite Caprock and mixed Halite Salt (<50%) encountered.
- 16 July 2013:** Condition borehole, trip out, complete geophysical wireline logging from 766' to 3257' bgs.
- 16-23 July 2013:** Remove BOP. Drill 28" diameter ream/opener BHA for 24" diameter Intermediate Casing Interval from 725' to 1795' bgs.
- 23-24 July 2013:** Downtime for repairs to drawworks.
- 25-26 July 2013:** Trip out, change out bit, modify BHA & Air-Lift Tube change over position, trip in and drill 28" diameter ream/opener borehole from 1795' to 1915' bgs.
- 26-28 July 2013:** At drill depth of 1915' bgs, borehole collapsed on top of BHA. Trip in BQ tremmie pipe, condition & weight up mud, clean, flush borehole then work rods to free-up sand-locked drill string.
- 28-31 July 2013:** Drill/advance 28" diameter ream/opener bore hole for 24" diameter Intermediate Casing Interval from 1915' to 2084' bgs . Sawyers Systems Engineer and Boart Mechanics running diagnostic tests on computer program, control panel, hydraulics, valving & electrical system components.

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
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		6. IF INDIAN, ALLOTTEE OR TRIBE NAME:
		7. UNIT or CA AGREEMENT NAME:
1. TYPE OF WELL Gas Storage Well		8. WELL NAME and NUMBER: CW-5
2. NAME OF OPERATOR: MAGNUM NGLS SOLUTION MINING LLC		9. API NUMBER: 43027500020000
3. ADDRESS OF OPERATOR: 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	PHONE NUMBER: 801 993-7001 Ext	9. FIELD and POOL or WILDCAT: UNDESIGNATED
4. LOCATION OF WELL FOOTAGES AT SURFACE: 0147 FSL 0167 FWL QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		COUNTY: MILLARD
		STATE: UTAH

11.

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TYPE OF SUBMISSION	TYPE OF ACTION		
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION  <input checked="" type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION  OTHER: <u>Monthly Report-September 2</u>
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 9/30/2013			
<input type="checkbox"/> SPUD REPORT Date of Spud:			
<input type="checkbox"/> DRILLING REPORT Report Date:			

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum Cavern Well #CW-5 Monthly Status Report for September, 2013 (API No. 43027500020000; APD No. 4838): See Attachment for Summary.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 October 07, 2013

NAME (PLEASE PRINT) Tiffany A. James	PHONE NUMBER 801 993-7001	TITLE Vice President Project Development
SIGNATURE N/A	DATE 10/3/2013	

**Magnum Cavern Storage Well #CW-5 – September 2013 Monthly Status Report Summary**

**01 Sept., 2013:** Trip out 24" diameter under-reamer; run caliper log in open hole from 3,153'-3,470' & begin installing 20" diameter casing string.

**02-05 Sept., 2013:** Install 20" diameter casing. Land casing at 3,460' bgs. Trip in, stab into float shoe, circulate and flush annulus in preparation for cementing. Cement casing annulus & trip drill string out. Wait on cement to cure.

**06-07 Sept., 2013:** Install 20" wellhead, mount BOP on wellhead and pressure test 20" wellhead, casing and BOP.  
**Test results: 40-minute duration test. Surface Test Pressure: 1,000 psi. Pressure Loss: 0 psi / 0%.**

**08-11 Sept., 2013:** Ream out float/grout shoe & cement in lead joint of 20" diameter casing. Trip-out, re-tool with 22" diameter under-reamer BHA, trip in and under-ream/open hole below 20" casing from 3,473'-3,585' bgs. Perform geophysical wireline survey of open hole and also a cement bond log survey of the 20" diameter casing.

**11-15 Sept., 2013** Install 16" diameter casing, stab-in to float shoe, cement casing annulus & wait on cement to cure.

**16 Sept., 2013:** Mount BOP and pressure test 16" diameter casing & BOP.  
**Test results: 30-minute duration test. Surface Test Pressure: 440 psi. Pressure Loss: 15 psi / 3%.**  
 Trip in and ream out float collar, grout shoe and cement inside lead joint of casing and drill 22' below bottom of 16" casing.

**17 Sept., 2013:** Complete 16" diameter Casing Seat & Annular Cement Pressure Test.  
**Test results: 60-minute duration test. Surface Test Pressure: 910 psi. Pressure Loss: 30 psi / 3%.**

**17-23 Sept. 2013:** Trip in 12 ¼" tooling. Drill pilot hole for suspended leaching casing strings from 3,598'-4,820' bgs (TD of Borehole). Perform borehole deviation surveys on ~100' intervals while drilling.

**23-24 Sept., 2013:** Perform geophysical wireline logging of pilot hole.

**24-27 Sept., 2013:** Re-tool using 17½" diameter under-reamer BHA and open up pilot hole from 3,598'-4,030, bgs. Trip Out, re-tool with 12¼" bit/BHA.

**28- 29 Sept., 2013** Clean out previously drilled pilot hole from 4,030' – 4,820' bgs.  
**TD of Cavern Well #CW-5 @ 4,820 feet below ground surface.**  
 Condition, clean & circulate borehole in preparation for final trip out.  
 Perform wireline gyro-survey down center of drill string from 0-3,700' bgs.  
 Trip drill tooling/string out of hole.

**28-29 Sept., 2013:** Perform wireline cement bond logging for 16" diameter casing string from bottom of 24" casing to bottom of 16" casing (~3,153-3,576' bgs).  
 Nipple/torque up 16" x 13-3/8" casing spooling, casing hanger seals & wellhead.  
 Pressure test casing hanger seals at 3,600 psi shut-in pressure for 20-30 minutes (4 tests) – all pressure tests passed and held.

**30 Sept, 2013:** Finish wireline cast & casing inspection logging (using high-resolution sonic tooling) for the 16" diameter casing string.  
 Installed 13-3/8" Diameter 72lb/ft, NT-80 BTC Suspended Leaching Casing String. Casing Landed at 4,002.19' bgs.

**\*Note: All drilling, casing installation, cementation, wireline logging and pressure testing procedures were completed successfully and directly conform to Project & Permit Specifications, and Requirements with exception to a minor modification was made to the drilling plan. The 12 1/4" diameter pilot hole was advanced through the bottom of the 20" CSG interval to the approximate depth of the 16" CSG Interval to a depth of 3,525' bgs. This was done so that one mobilization for the geophysical wireline tools could be combined for both intervals, and to further define top of salt, the transition into cleaner, more pure salt with higher halite content and to pre-determine 20" & 16" casing landing depths. Also, the landing depth for the 13-5/8" diameter suspended leaching casing string was adjusted. The conceptual design landing depth was proposed at 4,250' bgs; the actual landing depth is at 4,002.19' bgs. The depth was revised based upon a review of the geophysical wireline logs.**

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
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<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
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<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH

11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 10/12/2013	<input type="checkbox"/> ALTER CASING
<input type="checkbox"/> SPUD REPORT Date of Spud:	<input type="checkbox"/> CASING REPAIR
<input type="checkbox"/> DRILLING REPORT Report Date:	<input type="checkbox"/> CHANGE TO PREVIOUS PLANS
	<input type="checkbox"/> CHANGE WELL STATUS
	<input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS
	<input type="checkbox"/> DEEPEN
	<input type="checkbox"/> FRACTURE TREAT
	<input type="checkbox"/> OPERATOR CHANGE
	<input type="checkbox"/> PLUG AND ABANDON
	<input type="checkbox"/> PRODUCTION START OR RESUME
	<input type="checkbox"/> RECLAMATION OF WELL SITE
	<input type="checkbox"/> REPERFORATE CURRENT FORMATION
	<input type="checkbox"/> SIDETRACK TO REPAIR WELL
	<input type="checkbox"/> TUBING REPAIR
	<input type="checkbox"/> VENT OR FLARE
	<input type="checkbox"/> WATER SHUTOFF
	<input type="checkbox"/> SI TA STATUS EXTENSION
	<input type="checkbox"/> WILDCAT WELL DETERMINATION
	<input checked="" type="checkbox"/> OTHER
	OTHER: Monthly Report-October 2013

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum Cavern Well #CW-5 Monthly Status Report for October, 2013 (API No. 43027500020000; APD No. 4838): The attached summary provides an overview of activities completed at Magnum Cavern Well #CW-5 during the month of October. Cavern drilling was completed on October 12, 2013. Drilling, installation and testing activities were in direct accordance with project specifications and Utah DOGM Application Permit to Drill requirements. A Well Completion Report (Form 8) will be submitted within 30-days.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 October 30, 2013

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 10/29/2013	

**Magnum Cavern Storage Well #CW-5 – October 2013 Monthly Status Report Summary**

**01 Oct., 2013:** Installed the 8-5/8" Diameter 32lb/ft, NT-55 HE Suspended Leaching Casing String. Casing Landed at 4,714.02' bgs. Casing seated in hanger, then the 13-3/8" and 8-5/8" casing spooling, flange bolts were torqued to API Specifications and the seal voids were pressure tested.  
**Test results: 15-minute duration test. Shut-in Test Pressure: 3,000 psi. Pressure Loss: 0 psi / 0%.**

**02-05 Oct., 2013:** Rigging down and moving equipment to begin rigging up on Cavern Well #CW-6.

**06 Oct., 2013:** Weir Seaboard completed final wellhead assembly, nipple-up and installed pressure gauges on wellhead.

**07 Oct., 2013:** Sonic Surveys (Houston, Texas) set up on well in preparation for Mechanical Integrity Testing.

**08 Oct., 2013** Sonic Surveys and CUDD Energy Services injected nitrogen through the 13-3/8" Suspended Casing String and displaced the brine drilling fluid to approximately 3,778' bgs. The well was then sealed off and shut-in.

**09-10 Oct., 2013:** Wait on pressure and temperature in well to stabilize before initiating Mechanical Integrity Test.

**11-12 Oct., 2013:** Perform & complete 24-Hour Mechanical Integrity Test and log the well. Final MIT Logs and Reports are pending and will be submitted under separate cover.

**12 Oct. 2013:** Connect production water and brine line to wellhead manifolds.  
**Completion of Cavern Well CW-5 Drilling, Installation & Testing Activities.**

**13 Oct., 2013:** Initiate solution mining of Cavern Well CW-5.

**\*Note:** All drilling, casing installation, pressure testing and mechanical integrity testing procedures were completed successfully and directly conform to Project & Permit Specifications, Requirements and Tolerances.



<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
		5. LEASE DESIGNATION AND SERIAL NUMBER: 51573-OBA
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		6. IF INDIAN, ALLOTTEE OR TRIBE NAME:
		7. UNIT or CA AGREEMENT NAME:
1. TYPE OF WELL Gas Storage Well		8. WELL NAME and NUMBER: CW-5
2. NAME OF OPERATOR: MAGNUM NGLS SOLUTION MINING LLC		9. API NUMBER: 43027500020000
3. ADDRESS OF OPERATOR: 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	PHONE NUMBER: 801 993-7001 Ext	9. FIELD and POOL or WILDCAT: UNDESIGNATED
4. LOCATION OF WELL FOOTAGES AT SURFACE: 0147 FSL 0167 FWL QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		COUNTY: MILLARD
		STATE: UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION		
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION  <input checked="" type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION  OTHER: <u>Monthly Status Report-August</u>
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 8/31/2013			
<input type="checkbox"/> SPUD REPORT Date of Spud:			
<input type="checkbox"/> DRILLING REPORT Report Date:			

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum Cavern Well W-5 Monthly Status Report for August, 2013 (API No. 43027500020000; APD No. 4838): See Attached Summary. Drilling activities were in direct accordance with project specifications and Utah DOGM Application Permit to Drill requirements with exception to a minor modification to the drilling plan in relation to the drilling of a pilot hole through the 20" casing interval to better determine the 20" & 16" casing landing depths. A separate subsequent report will be filed to provide additional detail on this minor change to previous plans.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 November 05, 2013

NAME (PLEASE PRINT) Tiffany A. James	PHONE NUMBER 801 993-7001	TITLE Vice President Project Development
SIGNATURE N/A		DATE 9/4/2013

**Magnum Cavern Storage Well # CW-5 – August 2013 Monthly Status Report Summary**

**01-04 August, 2013:** Ream/open pilot hole to 28" from 2084' to 2447'.

**05-11 August 2013:** Ream/open pilot hole to 28" diameter from 2447' to 3107'. Changed bit at 2810'. Circulated cleaned and swabbed borehole from 2810' to 2929'

**12-18 August 2013:** Ream/open pilot hole to 28" diameter from 3107' to 3162'. Ran wire line caliper log. Installed and cemented 24" diameter Intermediate Casing String. Wait on cement to cure.

**19 August 2013:** Wait on cement to cure and top off cement in upper 187 feet of annulus.

**20-21 August 2013** Assemble BOP and start pressure test of 24" diameter casing. The surface pressure test was completed successfully, and was within Project & Permit Specifications.  
**Test results: 30-minute duration test. Surface Test Pressure: 1,120 psi. Pressure Loss: 25 psi /2.2%.**

**21-22 August 2013:** Trip in 17 ½" tools and drilled out the float collar, grout shoe and concrete to 3,170'.

**23 August 2013:** Trip in 12 ¼" tooling. Mixed brine drill mud.

**24-25 August 2013:** Finished mixing brine mud in tanks and fill borehole. Drilled 12 ¼" borehole from 3,260' to 3,525'.

**26 August 2013:** Jet West performed wire line geophysical logging of hole from 3153' to 3,523'. Begin tripping in 21 ½" diameter BHA/drill string.

**27 August 2013** Complete Trip in of 21 ½" diameter BHA/drill string to ream out float collar, grout shoe and cement from 3,109' to 3,175'. Trip out 21 ½" BHA/drill string and retooled to 24" diameter under-reamer bottom-hole assembly and started to trip back into borehole.

**28-31 August 2013:** Under-ream/open pilot hole to 24" diameter from 3,175' to 3,470' for 20" diameter casing string Installation. TD of 24" diameter borehole = 3,470 feet bgs. The 20" diameter casing string will be set at 3,460 feet bgs target depth. Conditioned salt mud, circulated, cleaned and flushed borehole in preparation for trip out for caliper logging and casing installation. Begin trip out.

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		5. LEASE DESIGNATION AND SERIAL NUMBER: 51573-0BA
		6. IF INDIAN, ALLOTTEE OR TRIBE NAME:
		7. UNIT or CA AGREEMENT NAME:
1. TYPE OF WELL Gas Storage Well	8. WELL NAME and NUMBER: CW-5	
2. NAME OF OPERATOR: MAGNUM NGLS SOLUTION MINING LLC	9. API NUMBER: 43027500020000	
3. ADDRESS OF OPERATOR: 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	PHONE NUMBER: 801 993-7001 Ext	9. FIELD and POOL or WILDCAT: UNDESIGNATED
4. LOCATION OF WELL FOOTAGES AT SURFACE: 0147 FSL 0167 FWL QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S	COUNTY: MILLARD	
		STATE: UTAH

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CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION		
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input checked="" type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION <input type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION OTHER: <input type="text"/>
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 8/28/2013			
<input type="checkbox"/> SPUD REPORT Date of Spud:			
<input type="checkbox"/> DRILLING REPORT Report Date:			

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

A minor modification was made to the drilling plan. The 12 1/4" diameter pilot hole was advanced through the bottom of the 20" CSG interval to the approximate depth of the 16" CSG Interval to a depth of 3,525' bgs. This was done so that one mobilization for the geophysical wireline tools could be combined for both intervals, and to further define top of salt, the transition into cleaner, more pure salt with higher halite content and to pre-determine 20" & 16" casing landing depths.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 November 05, 2013

NAME (PLEASE PRINT) Tiffany A. James	PHONE NUMBER 801 993-7001	TITLE Vice President Project Development
SIGNATURE N/A		DATE 9/4/2013

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MININGAMENDED REPORT ☐ FORM 8  
(highlight changes)5. LEASE DESIGNATION AND SERIAL NUMBER:  
51573-OBA

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT or CA AGREEMENT NAME

8. WELL NAME and NUMBER:

Magnum Cavern Well #CW-5

9. API NUMBER:

4302750002

10 FIELD AND POOL, OR WILDCAT

Undesignated

11. QTR/QTR, SECTION, TOWNSHIP, RANGE,  
MERIDIAN:

SWSW 23 15S 7W S

12. COUNTY

Millard

13. STATE

UTAH

1a. TYPE OF WELL:

OIL WELL ☐GAS WELL ☐DRY ☐

OTHER Storage Well

b. TYPE OF WORK:


NEW WELL ☒HORIZ. LATS. ☐DEEP-EN ☐RE-ENTRY ☐DIFF. RESVR. ☐

OTHER

2. NAME OF OPERATOR:

Magnum NGLs Solution Mining, LLC

3. ADDRESS OF OPERATOR:

3165 E. Millrock Dr., St.  CITY Holladay

STATE UT

ZIP 84121

PHONE NUMBER:

(801) 993-7001

4. LOCATION OF WELL (FOOTAGES)

AT SURFACE: 0147 FSL 0167 FWL

AT TOP PRODUCING INTERVAL REPORTED BELOW: N/A

AT TOTAL DEPTH: 0245.59 FSL 0134.2 FWL

14. DATE SPUDDED:

5/15/2013

15. DATE T.D. REACHED:

9/28/2013

16. DATE COMPLETED:

10/12/2013

ABANDONED ☐READY TO PRODUCE ☐

17. ELEVATIONS (DF, RKB, RT, GL):

4,614.16 ft. MSL - GL

18. TOTAL DEPTH: MD

4,820

19. PLUG BACK T.D.: MD

TVD

20. IF MULTIPLE COMPLETIONS, HOW MANY? \*

CSG Strings-8

21. DEPTH BRIDGE MD

PLUG SET: TVD

22. TYPE ELECTRIC AND OTHER MECHANICAL LOGS RUN (Submit copy of each)

E-Logs, Caliper, CBL/CAST, Spectral Gamma & Gyro-Survey  
Hard Copies of Logs are enclosed.

23.

WAS WELL CORED?

NO ☒YES ☐

(Submit analysis)

WAS DST RUN?

NO ☒YES ☐

(Submit report)

DIRECTIONAL SURVEY?

NO ☐YES ☒

(Submit copy)

24. CASING AND LINER RECORD (Report all strings set in well)

HOLE SIZE	SIZE/GRADE	WEIGHT (#/ft.)	TOP (MD)	BOTTOM (MD)	STAGE CEMENTER DEPTH	CEMENT TYPE & NO. OF SACKS	SLURRY VOLUME (BBL)	CEMENT TOP **	AMOUNT PULLED
See Attached Summary.									

25. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)	SIZE	DEPTH SET (MD)	PACKER SET (MD)	SIZE	DEPTH SET (MD)	PACKER SET (MD)

26. PRODUCING INTERVALS

FORMATION NAME	TOP (MD)	BOTTOM (MD)	TOP (TVD)	BOTTOM (TVD)	INTERVAL (Top/Bot - MD)	SIZE	NO. HOLES	PERFORATION STATUS
(A) N/A								Open <input type="checkbox"/> Squeezed <input type="checkbox"/>
(B)								Open <input type="checkbox"/> Squeezed <input type="checkbox"/>
(C)								Open <input type="checkbox"/> Squeezed <input type="checkbox"/>
(D)								Open <input type="checkbox"/> Squeezed <input type="checkbox"/>

27. PERFORATION RECORD

28. ACID, FRACTURE, TREATMENT, CEMENT SQUEEZE, ETC.

WAS WELL HYDRAULICALLY FRACTURED?

YES ☐NO ☒

IF YES -- DATE FRACTURED:

DEPTH INTERVAL

AMOUNT AND TYPE OF MATERIAL

N/A

29. ENCLOSED ATTACHMENTS:

- ☒ ELECTRICAL/MECHANICAL LOGS
- ☐ GEOLOGIC REPORT
- ☐ DST REPORT
- ☒ DIRECTIONAL SURVEY
- ☐ SUNDRY NOTICE FOR PLUGGING AND CEMENT VERIFICATION
- ☐ CORE ANALYSIS
- ☐ OTHER: \_\_\_\_\_

30. WELL STATUS:

Completed

## 31. INITIAL PRODUCTION

## INTERVAL A (As shown in item #26)

DATE FIRST PRODUCED:		TEST DATE:		HOURS TESTED:		TEST PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	PROD. METHOD:
CHOKE SIZE:	TBG. PRESS.	CSG. PRESS.	API GRAVITY	BTU – GAS	GAS/OIL RATIO	24 HR PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	INTERVAL STATUS:

## INTERVAL B (As shown in item #26)

DATE FIRST PRODUCED:		TEST DATE:		HOURS TESTED:		TEST PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	PROD. METHOD:
CHOKE SIZE:	TBG. PRESS.	CSG. PRESS.	API GRAVITY	BTU – GAS	GAS/OIL RATIO	24 HR PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	INTERVAL STATUS:

## INTERVAL C (As shown in item #26)

DATE FIRST PRODUCED:		TEST DATE:		HOURS TESTED:		TEST PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	PROD. METHOD:
CHOKE SIZE:	TBG. PRESS.	CSG. PRESS.	API GRAVITY	BTU – GAS	GAS/OIL RATIO	24 HR PRODUCTION RATES: ➡	OIL – BBL:	GAS – MCF:	WATER – BBL:	INTERVAL STATUS:

## INTERVAL D (As shown in item #26)

DATE FIRST PRODUCED:		TEST DATE:		HOURS TESTED:		TEST PRODUCTION RATES: →	OIL – BBL:	GAS – MCF:	WATER – BBL:	PROD. METHOD:
CHOKE SIZE:	TBG. PRESS.	CSG. PRESS.	API GRAVITY	BTU – GAS	GAS/OIL RATIO	24 HR PRODUCTION RATES: →	OIL – BBL:	GAS – MCF:	WATER – BBL:	INTERVAL STATUS:

## 32. DISPOSITION OF GAS (Sold, Used for Fuel, Vented, Etc.)

## 33. SUMMARY OF POROUS ZONES (Include Aquifers):

Show all important zones of porosity and contents thereof: Cored intervals and all drill-stem tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures and recoveries.

## 34. FORMATION (Log) MARKERS:

Formation	Top (MD)	Bottom (MD)	Descriptions, Contents, etc.	Name	Top (Measured Depth)
Unconfined Aquifer	0	250	Unconsolidated sand, clay & occasional silt	Quaternary Unconsolidated	0
Shallow Artesian Aquifer	250	750	Unconsolidated sand, clay & occasional silt	Miocene Evaporites & Salt	3,184
Deep Artesian Aquifer	750	1,400	Unconsolidated sand, clay & occasional silt	Top of Salt Structure (Miocene)	3,184
Basement Artesian Aquifer	1,400	3,184	Unconsolidated sand, clay & occasional silt		

## 35. ADDITIONAL REMARKS (Include plugging procedure)

Please see attached documents for Casing, Cementing & Pressure Testing Information. Well As-Built Diagram and Geophysical Also included is a wireline logging summary. Hard copies of the wireline logs and the unconfined compressive strength lab reports to be sent separately.

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records.

NAME (PLEASE PRINT)

TIFFANY A. JAMES

TITLE

VP PROJECT DEVELOPMENT &amp; FORT. ARMY

SIGNATURE

DATE

11/1/13

This report must be submitted within 30 days of

- completing or plugging a new well
- drilling horizontal laterals from an existing well bore
- recompleting to a different producing formation
- reentering a previously plugged and abandoned well
- significantly deepening an existing well bore below the previous bottom-hole depth
- drilling hydrocarbon exploratory holes, such as core samples and stratigraphic tests

\* ITEM 20: Show the number of completions if production is measured separately from two or more formations.

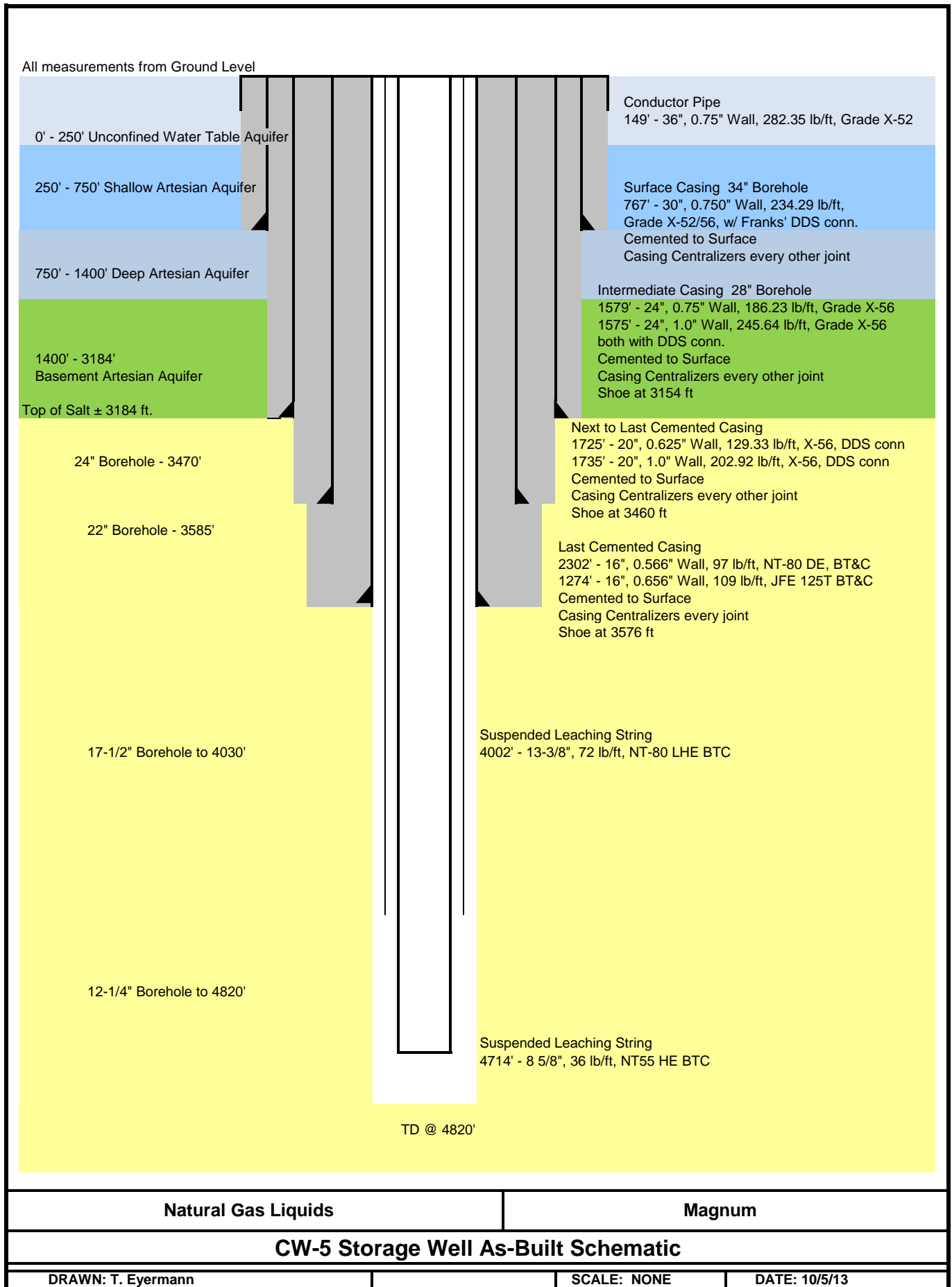
\*\* ITEM 24: Cement Top – Show how reported top(s) of cement were determined (circulated (CIR), calculated (CAL), cement bond log (CBL), temperature survey (TS)).

Send to: Utah Division of Oil, Gas and Mining  
1594 West North Temple, Suite 1210  
Box 145801  
Salt Lake City, Utah 84114-5801

Phone: 801-538-5340

Fax: 801-359-3940





**Magnum Cavern Well CW-5**  
**Summary of Casing Installations, As-Built and Pressure Tests**

Borehole Diameter (in.) Depth Interval (Ft. bgs)	CSG Size/Grade	CSG Weight (lbs/ft)	Thread/Connector Type	Optimum Torque (ft/lbs)	CSG Top (ft.)	CSG Bottom (ft)	Method of Cement Placement - Depth	Cement Type / # of Sacks	Slurry Volume (Gal / BBLs)	Cement Top (ft)	BOP/Casing Pressure Test
55" Diameter 0.0 - 19.6'	48"-dia. x 0.375" Wall	N/A	N/A - Single Joint	N/A	0.0'	19.6'	Gravity feed from surface	Type I/II Neat Portland Cement w/ 2% calcium Class A / 64.5 Sacks	570-Gallons / 13.6 BBLs	0.0'	N/A
44" Diameter 19.6 - 151'	36"-dia. x 0.75" Wall Grade X52M	282.35 lbs/ft	Welded	N/A	+0.3'	148.85'	Tremmie from bottom to top	Type I/II Neat Portland Cement w/ 1% Calcium Class A / 580.5 Sacks	6,060 Gallons / 144.3 BBLs	0.0'	N/A
34" Diameter 151 - 771.93'	30"-dia. x 0.75" Wall Grade X56/52M	234.29 lbs/ft	DDS Threaded Box x Pin	45,000	+0.1'	766.93'	5½" Stab-in to Float Collar @ -728" - Pressure Grout	Type I/II Neat Portland Cement Class A 1,290 Sacks	11,400 Gallons / 271.4 BBLs	0.0'	Shut-in @500 psi. Duration:30-minutes. Pressure Loss: 30 psi/6%.
28" Diameter 771.93' - 3,162'	A) 24"-dia. x 0.75" wall Grade X56 B) 24"-dia. x 1.0" wall Grade X56	A) 186.23 lbs/ft B) 245.64 lbs/ft	DDS Threaded Box x Pin	36,000	A) +0.5' B) 1,579.28'	A) 1,579.28' B) 3,153.57'	5½" Stab-in to Float Collar @ -728" - Pressure Grout	Ash Grove Type II-V Portland Cement Class A / 4,550 Sacks	41,520 Gallons / 988.6 BBLs	0.5'	Shut-in @1,145 psi. Duration:30-minutes. Pressure Loss: 25 psi/2%.
24" Diameter 3,162' - 3,470'	A) 20"-dia. x 0.625" Wall Grade X56 B) 20"-dia. x 1.0" Wall Grade X56	A) 129.33 lbs/ft B) 202.92 lbs/ft	DDS Threaded Box x Pin	30,000	A) 0.5' B) 1,724.85'	A) 1,724.85' B) 3,460'	5½" Stab-in to Float Collar @ -3,423.62" - Pressure Grout	Type G (Premium) Cement (37.2% salt, 0.2% air out) Class G / 1,853 Sacks	17,187.2 Gallons / 409.22 BBLs	0.5'	Shut-in @1,000 psi. Duration:40-minutes. Pressure Loss: 0 psi/0%.
22" Diameter 3,470' - 3,585'	A) 16"-dia. x 0.566" Wall NT-80 DE B) 16"-dia. x 0.656" Wall JTE 125T	A) 97.0 lbs/ft B) 109.0 lbs/ft	A) GB BTC B) API BTC	-16,000	A) +3.33' B) 2,302.41'	A) 2,302.41' B) 3,575.94'	5½" Stab-in to Float Collar @ -3,520.33" - Pressure Grout	Type G (Premium) Cement (37.2% salt, 0.2% air out) Class G / 1,548 Sacks	14,280 Gallons / 340 BBLs	+2.0'	<u>Casing Test:</u> Shut-in @440 psi. Duration:30-minutes. Pressure Loss: 15 psi/3%. <u>Casing Seat Test:</u> Shut-in @ 910 psi. Duration: 60-minutes. Pressure Loss: 30 psi/3%
17.5" Diameter 3,585' - 3,591' 14.5" Diameter 3,591' - 3,598' 17.5" Diameter 3,598' - 4,030'	13-3/8"-dia. x 0.514" Wall NT-80 LHE	72.0 lbs/ft	Buttress Threaded BT&C	N/A	+5.8'	4,002.19'	N/A - Suspended CSG	N/A - Suspended CSG	N/A - Suspended CSG	N/A - Suspended CSG	N/A
12¼" Diameter 4,030' - 4,820 (TD)	8-5/8"-dia. x 0.352" Wall NT-55 HE	32.0 lbs/ft	API 8 Long Round LT&C	4,170	+8.83'	4,714.02'	N/A - Suspended CSG	N/A - Suspended CSG	N/A - Suspended CSG	N/A - Suspended CSG	N/A





## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** July 01, 2013  
**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well #CW-5

**Attn:** Sam Quigley

**Architect:**

**Engineer:**

**Project Manager:**

**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 6/3/2013

**Contractor:** Boart Longyear

**Inspector:** Nick Anderson

**Type of Placement:** Portland Type 1

**Location:** Portland Type I/II Cement Slurry 30" Casing Annulus Section 1 Batch #3

**Strength:** Required (f'c) : 4000 psi @ 28 Days

**Mix #:**

**Supplier:** Quickcrete

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:**

**Batch Size (cy):**

**Water Added (gal):**

**Admixture:** Halliburton Retarder HR-5

Actual

Specs

**Slump (in) ASTM C143-10:**

**\*Apparent Air Content (%) ASTM C231-10:**

**Unit Weight (pcf) ASTM C138-10:**

**Sample Temperature (°F) ASTM C1064-08:** 90

**Ambient Temperature (°F):** 75

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Time

**Batch Time:** 8:58

**Sampled Time:** 9:00

**Finish Time:** 9:01

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013354	A	6/4/2013	6/10/2013	7	2x4	3.14	10710	3410	3	<input type="checkbox"/>	Su	85%
	B	6/4/2013	7/1/2013	28	2x4	3.14	13250	4220	2	<input type="checkbox"/>	Gy	106%
	C	6/4/2013	7/1/2013	28	2x4	3.14	12950	4120	2	<input type="checkbox"/>	Gy	103%
	D	6/4/2013	7/1/2013	28	2x4	3.14	12870	4100	2	<input type="checkbox"/>	Gy	103%

Final Curing Condition is Moisture Room unless otherwise noted.

**Break Types:** -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

**Type of Caps:** -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

**Note:** All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: N. Godding

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
Email: ☐

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Sandy, UT 84070  
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## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** September 16, 2013  
**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well CW-6

**Attn:** Sam Quigley

**Architect:**

**Engineer:**

**Project Manager:**

**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 8/17/2013

**Contractor:** Boart Longyear

**Type of Placement:** Well Casing

**Inspector:** Nick Anderson

**Location:** Cavern Well #CW-5, 24" Diameter Casing

**Strength:** Required (f'c) : 4000 psi @ 28 Days

**Mix #:**

**Supplier:** Quikrete

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:** Site Batch

**Batch Size (cy):**

**Water Added (gal):**

**Admixture:**

### Time

**Batch Time:** 4:45

**Sampled Time:** 4:55

**Finish Time:** 4:45

	<u>Actual</u>	<u>Specs</u>
Slump (in) ASTM C143-10:		
*Apparent Air Content (%) ASTM C231-10:		
Unit Weight (pcf) ASTM C138-10:		
Sample Temperature (°F) ASTM C1064-08:	83	
Ambient Temperature (°F):	69	

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013501	A	8/18/2013	8/24/2013	7	2x4	3.14	9490	3020	3	<input type="checkbox"/>		76%
	B	8/18/2013	9/14/2013	28	2x4	3.14				<input type="checkbox"/>		
	C	8/18/2013	9/14/2013	28	2x4	3.14				<input type="checkbox"/>		
	D	8/18/2013	9/14/2013	28	2x4	3.14				<input type="checkbox"/>		

Final Curing Condition is Moisture Room unless otherwise noted.

**Break Types:** -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

**Type of Caps:** -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

**Note:** All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: \_\_\_\_\_

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
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## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** September 16, 2013

**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well CW-6

**Attn:** Sam Quigley

**Architect:**

**Engineer:**

**Project Manager:**

**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 8/17/2013

**Contractor:** Boart Longyear

**Type of Placement:** Well Casing

**Inspector:** Nick Anderson

**Location:** Cavern Well #CW-5, 24" Diameter Casing

**Strength:** Required (f'c) : 4000 psi @ 28 Days

**Mix #:**

**Supplier:** Quikrete

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:** Site Batch

**Batch Size (cy):**

**Water Added (gal):**

**Admixture:**

### Time

**Batch Time:** 4:45

**Sampled Time:** 4:55

**Finish Time:** 4:45

	<u>Actual</u>	<u>Specs</u>
Slump (in) ASTM C143-10:		
*Apparent Air Content (%) ASTM C231-10:		
Unit Weight (pcf) ASTM C138-10:		
Sample Temperature (°F) ASTM C1064-08:	83	
Ambient Temperature (°F):	69	

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013501	A	8/18/2013	8/24/2013	7	2x4	3.14	9490	3020	3	<input type="checkbox"/>		76%
	B	8/18/2013	9/14/2013	28	2x4	3.14	13100	4170		<input type="checkbox"/>	Un	104%
	C	8/18/2013	9/14/2013	28	2x4	3.14	12800	4070		<input type="checkbox"/>	Un	102%
	D	8/18/2013	9/14/2013	28	2x4	3.14	14010	4460		<input type="checkbox"/>	Un	112%

Final Curing Condition is Moisture Room unless otherwise noted.

**Break Types:** -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

**Type of Caps:** -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

**Note:** All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: 

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## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** October 02, 2013  
**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well CW-5

**Attn:** Sam Quigley

**Architect:**  
**Engineer:**

**Project Manager:**  
**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 9/12/2013

**Contractor:** Nabors

**Type of Placement:** Pressure Grout

**Inspector:**

**Location:** 16" Casing Annulus

**Strength:** Required (f'c) : 2500 psi @ 28 Days

**Mix #:** 1

**Supplier:** Site Batch

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:** On-Site

**Batch Size (cy):**

**Water Added (gal):** 4.94

**Admixture:** H2O Sack/Type G (Premium)  
Cement + 37.2% Salt, 0.2%  
Air Out

**Time**

**Batch Time:**

**Sampled Time:**

**Finish Time:**

**Slump (in) ASTM C143-10:**

**\*Apparent Air Content (%) ASTM C231-10:**

**Unit Weight (pcf) ASTM C138-10:**

**Sample Temperature (°F) ASTM C1064-08:** 78

**Ambient Temperature (°F):** 74

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013599	A	9/13/2013	9/26/2013	14	2x4	3.14	6220	1980	3	<input type="checkbox"/>	Un	79%
	B	9/13/2013	10/10/2013	28	2x4	8.00				<input type="checkbox"/>		
	B	9/13/2013	10/10/2013	28	2x4	8.00				<input type="checkbox"/>		
	C	9/13/2013	10/10/2013	28	2x4	8.00				<input type="checkbox"/>		

Final Curing Condition is Moisture Room unless otherwise noted.

Break Types: -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

Type of Caps: -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

Note: All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: *D. Fadling*

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
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## Report of Compression Test Results

Client: Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

Report Date: October 03, 2013  
Project #: 74201409C0B200

Project Name: Magnum Cavern Well CW-5

Attn: Sam Quigley

Architect:  
Engineer:

Project Manager:

Specimen Type: Grout, Cylinders ASTM C39-10

### Mix and Field Data

CastDate: 9/4/2013

Type of Placement: Pressure Grout

Contractor: Nabors  
Inspector: Scott Bourcy

Location: 20" Casing Annulus from 3,470' To Surface Inside 24" Casing and Drilled Borehole

Strength: Required (f'c) : 4000 psi @ 28 Days

Mix #: Batch #3

Supplier: Nabors Completion Service

Load: of

Truck #:

Ticket #:

Plant #: On Site

Batch Size (cy):

Water Added (gal):

Admixture: Mud Weight=16.30lbs/gallon

Mix Ratio=1Sac Type G

(Premium Cement) 4.94gal

H2O:37.2%

Salt/yield=1.23ft3/Sack

Time

Batch Time: 0:45

Sampled Time: 1:15

Finish Time: 1:24

Remarks: 5 1/2" FH Float Collar/Shoe Stab-In Method

Actual

Specs

Slump (in) ASTM C143-10:

\*Apparent Air Content (%) ASTM C231-10:

Unit Weight (pcf) ASTM C138-10:

Sample Temperature (°F) ASTM C1064-08: 82

Ambient Temperature (°F): 65

Clouds Condition: Clear

Precipitation:

Wind Condition:

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013537	A	9/5/2013	9/11/2013	7	2x3.98	3.14	8140	2590	3	<input type="checkbox"/>	Un	65%
	B	9/5/2013	10/2/2013	28	2x4	3.14	13190	4200	5	<input type="checkbox"/>	Un	105%
	C	9/5/2013	10/2/2013	28	2x4	3.14	14810	4710	5	<input type="checkbox"/>	Un	118%
	D	9/5/2013	10/2/2013	28	2x4	3.14	13280	4230	5	<input type="checkbox"/>	Un	106%

Final Curing Condition is Moisture Room unless otherwise noted.

Break Types: -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

Type of Caps: -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

Note: All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: 

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
Email: ☐

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## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** October 03, 2013  
**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well CW-5

**Attn:** Sam Quigley

**Architect:**

**Engineer:**

**Project Manager:**

**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 8/17/2013

**Contractor:** Boart Longyear

**Type of Placement:** Well Casing

**Inspector:** Nick Anderson

**Location:** Cavern Well #CW-5, 24" Diameter Casing

**Strength:** Required (f'c) : 4000 psi @ 28 Days

**Mix #:**

**Supplier:** Quikrete

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:** Site Batch

**Batch Size (cy):**

**Water Added (gal):**

**Admixture:**

### Time

**Batch Time:** 4:45

**Sampled Time:** 4:55

**Finish Time:** 4:45

Actual

Specs

**Slump (in) ASTM C143-10:**

**\*Apparent Air Content (%) ASTM C231-10:**

**Unit Weight (pcf) ASTM C138-10:**

**Sample Temperature (°F) ASTM C1064-08:** 83

**Ambient Temperature (°F):** 69

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013501	A	8/18/2013	8/24/2013	7	2x4	3.14	9490	3020	3	<input type="checkbox"/>		76%
	B	8/18/2013	9/14/2013	28	2x4	3.14	13100	4170		<input type="checkbox"/>	Un	104%
	C	8/18/2013	9/14/2013	28	2x4	3.14	12800	4070		<input type="checkbox"/>	Un	102%
	D	8/18/2013	9/14/2013	28	2x4	3.14	14010	4460		<input type="checkbox"/>	Un	112%

Final Curing Condition is Moisture Room unless otherwise noted.

**Break Types:** -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

**Type of Caps:** -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

**Note:** All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: 

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
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## Report of Compression Test Results

**Client:** Magnum Energy  
3165 East Mill Rock Drive Suite 330  
Holiday, UT 84121

**Report Date:** October 28, 2013  
**Project #:** 74201409C0B200

**Project Name:** Magnum Cavern Well CW-5

**Attn:** Sam Quigley

**Architect:**

**Engineer:**

**Project Manager:**

**Specimen Type:** Grout, Cylinders ASTM C39-10

### Mix and Field Data

**CastDate:** 9/12/2013

**Contractor:** Nabors

**Type of Placement:** Pressure Grout

**Inspector:**

**Location:** 16" Casing Annulus

**Strength:** Required (f'c) : 2500 psi @ 28 Days

**Mix #:** 1

**Supplier:** Site Batch

**Load:** of

**Truck #:**

**Ticket #:**

**Plant #:** On-Site

**Batch Size (cy):**

**Water Added (gal):** 4.94

**Admixture:** H2O Sack/Type G (Premium)

Cement + 37.2% Salt, 0.2%

Air Out

### Time

**Batch Time:**

**Sampled Time:**

**Finish Time:**

Actual

Specs

**Slump (in) ASTM C143-10:**

**\*Apparent Air Content (%) ASTM C231-10:**

**Unit Weight (pcf) ASTM C138-10:**

**Sample Temperature (°F) ASTM C1064-08:** 78

**Ambient Temperature (°F):** 74

**Clouds Condition:**

**Precipitation:**

**Wind Condition:**

### Test Results

Lab Id	Spec Id	Date Received	Test Date	Age (Days)	Nominal Specimen Size	Actual Area (in <sup>2</sup> )	Compressive (lbs)	Strength (psi)	Break Type	Field Cure	Type of Cap	Percent of Req.
2013599	A	9/13/2013	9/26/2013	14	2x4	3.14	6220	1980	3	<input type="checkbox"/>	Un	79%
	B	9/13/2013	10/10/2013	28	2x4	3.14	9880	3140	3	<input type="checkbox"/>	Un	126%
	B	9/13/2013	10/10/2013	28	2x4	3.14	10440	3320	3	<input type="checkbox"/>	Un	133%
	C	9/13/2013	10/10/2013	28	2x4	3.14	11320	3600	3	<input type="checkbox"/>	Un	144%

**Final Curing Condition is Moisture Room unless otherwise noted.**

**Break Types:** -- 1-Well form cones on both end and less than 1" of cracking through caps, 2-Well formed cone on one end and vertical cracks running through caps, 3-Columnar with vertical cracking through both ends, 4-Diagonal fracture with no cracking through ends, 5-Side fractures at top or bottom, 6-Similar to 5 but end of cylinder is pointed.

**Type of Caps:** -- (Un) Unbonded ASTM C1231, (Su) Sulfur Based Compound ASTM C617, (Gr) Grinding, (Gy) Gypsum

**Note:** All tests performed by the laboratory or its agents were in accordance with the applicable test methods.

\* Aggregate Correction Factor not supplied therefore not used in calculation of Air Content.

Reviewed By: 

**Distribution:** Client ☒ File: ☒ Supplier: ☒ Other: Addressee (2)  
Email: ☐

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Sandy, UT 84070  
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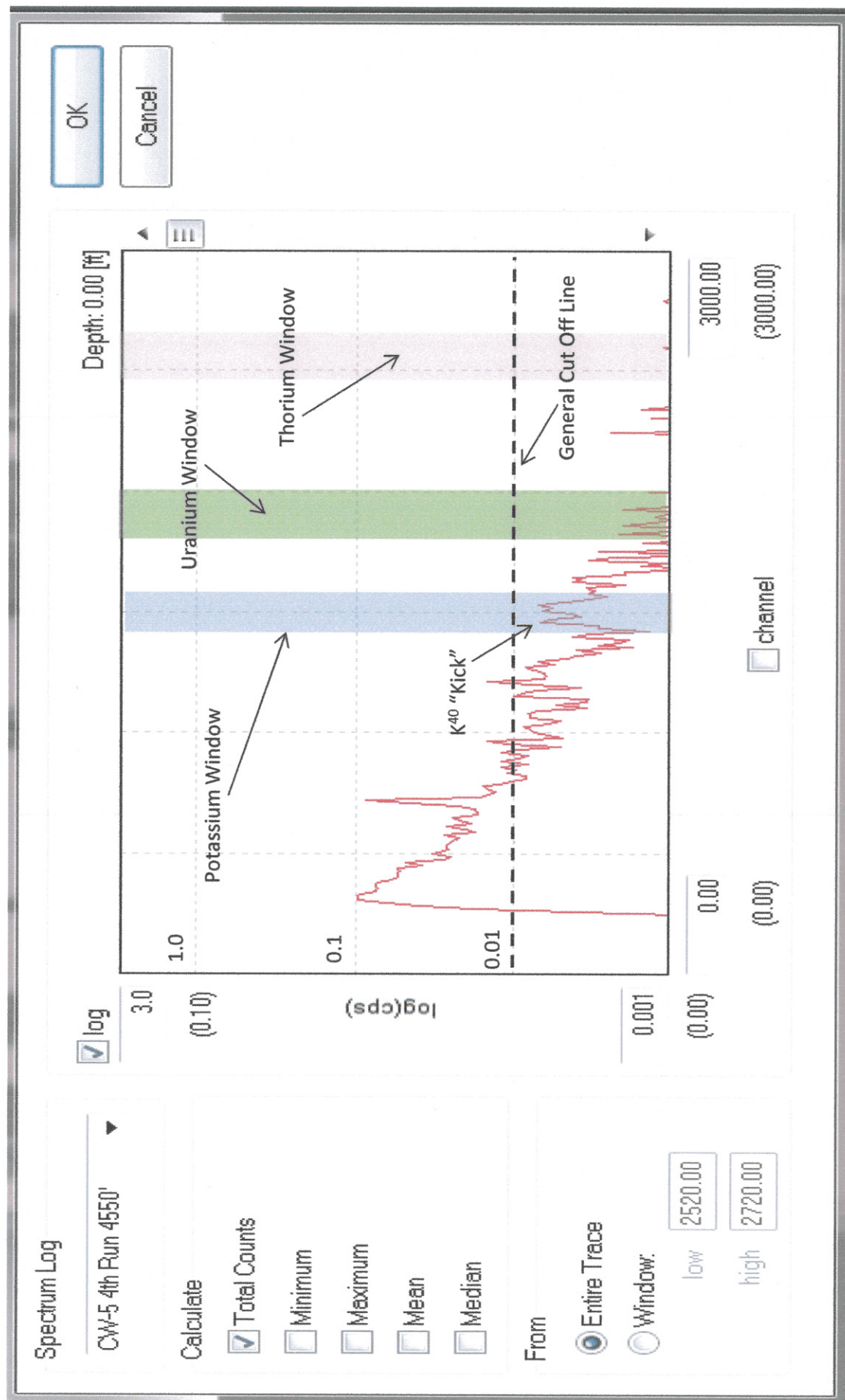
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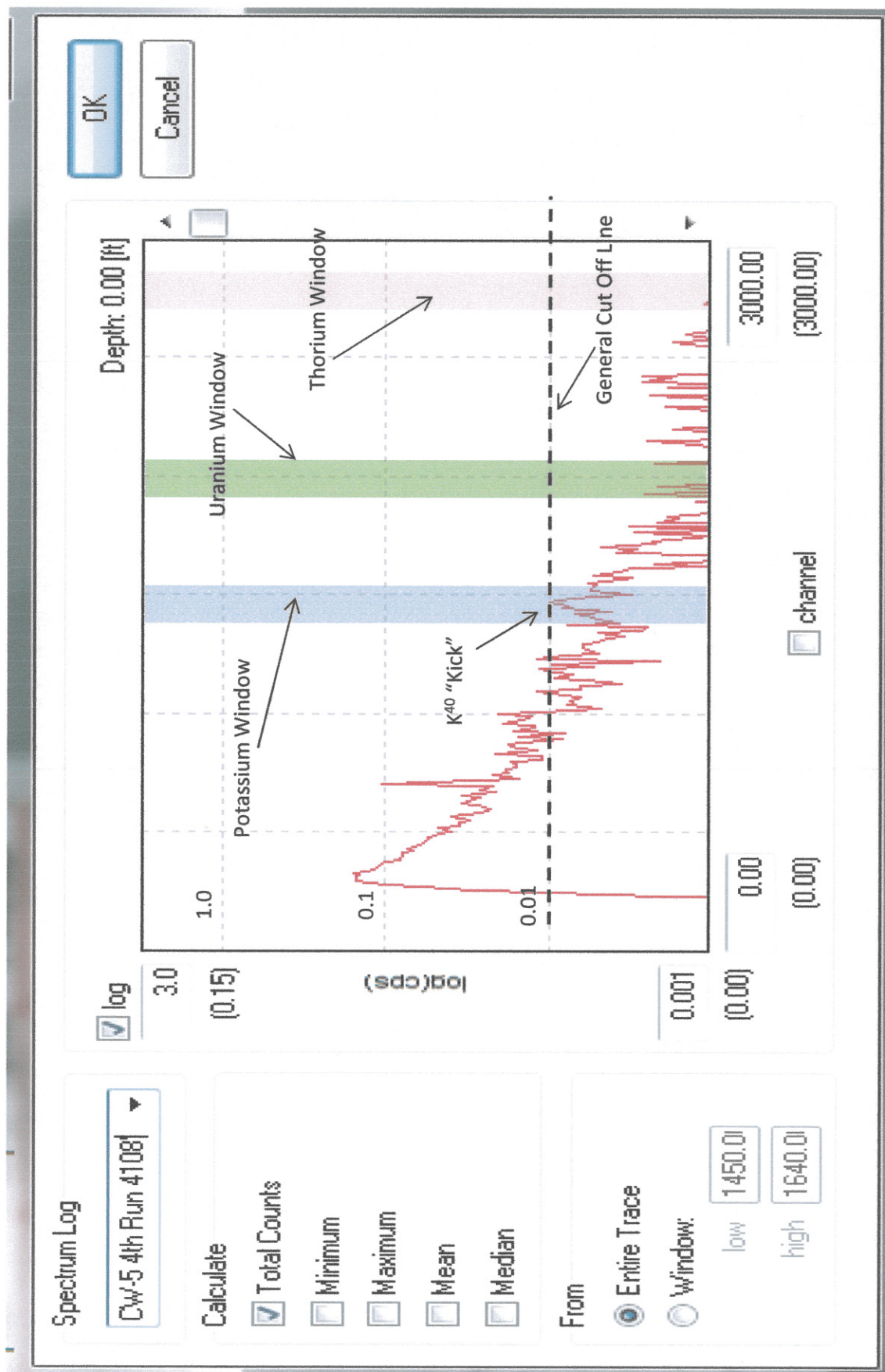
**Magnum NGLs Cavern Well #CW-5 - Geophysical Wireline Log Summary**

<b>Date Logging Completed</b>	<b>Log Type</b>	<b>Depth - Log Interval (ft bgs)</b>	<b>Logging Company</b>	<b>Purpose</b>
23-May-03	E-Log	0' - 753'	Jet West Geophysical Services	30" CSG String
30-May-13	Caliper	0' - 772'	Jet West Geophysical Services	30" CSG String
16-Jul-13	E-Log	766' - 3,260'	Jet West Geophysical Services	24" CSG String
13-Aug-13	Caliper	0' - 3,260'	Jet West Geophysical Services	24" CSG String
26-Aug-13	E-Log	3,080' - 3,525'	Jet West Geophysical Services	20" & 16" CSG Strings
1-Sep-03	Caliper	0' - 3,525'	Jet West Geophysical Services	20" CSG String
10-Sep-13	Caliper	3,280' - ~3,588'	Century Wireline Services	16" CSG String
11-Sep-13	CBL	2,950' - ~ 3,500'	Century Wireline Services	20" CSG String
24-Sep-13	E-Log & Spectral Gamma	3,576' - 4,820'	Jet West Geophysical Services	13-5/8" & 8-5/8" Suspended CCG Strings
28-Sep-13	Gyro-Survey	0' - 3,637'	Century Wireline Services	Borehole
29-Sep-13	CBL & CAST	3,100' - 3,535'	Halliburton	20" & 16" CSG Strings
7-12 Oct 2013	MIT	<b>*Note:</b> Mechanical Integrity Testing Data/Logs to be addressed under sperate cover.		

# CW-5 Window at 4550 Feet

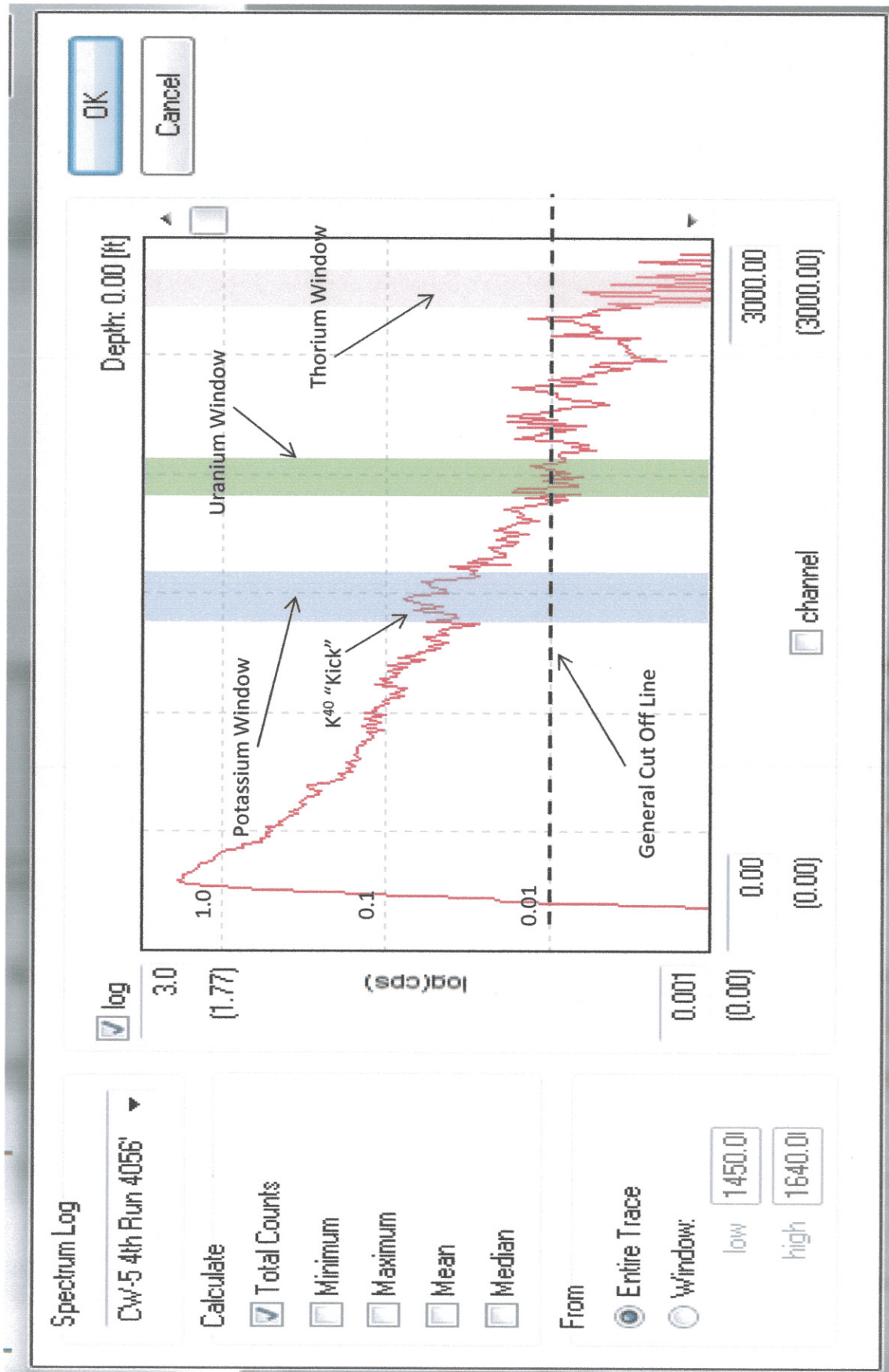


# CW-5 Window at 4108 Feet

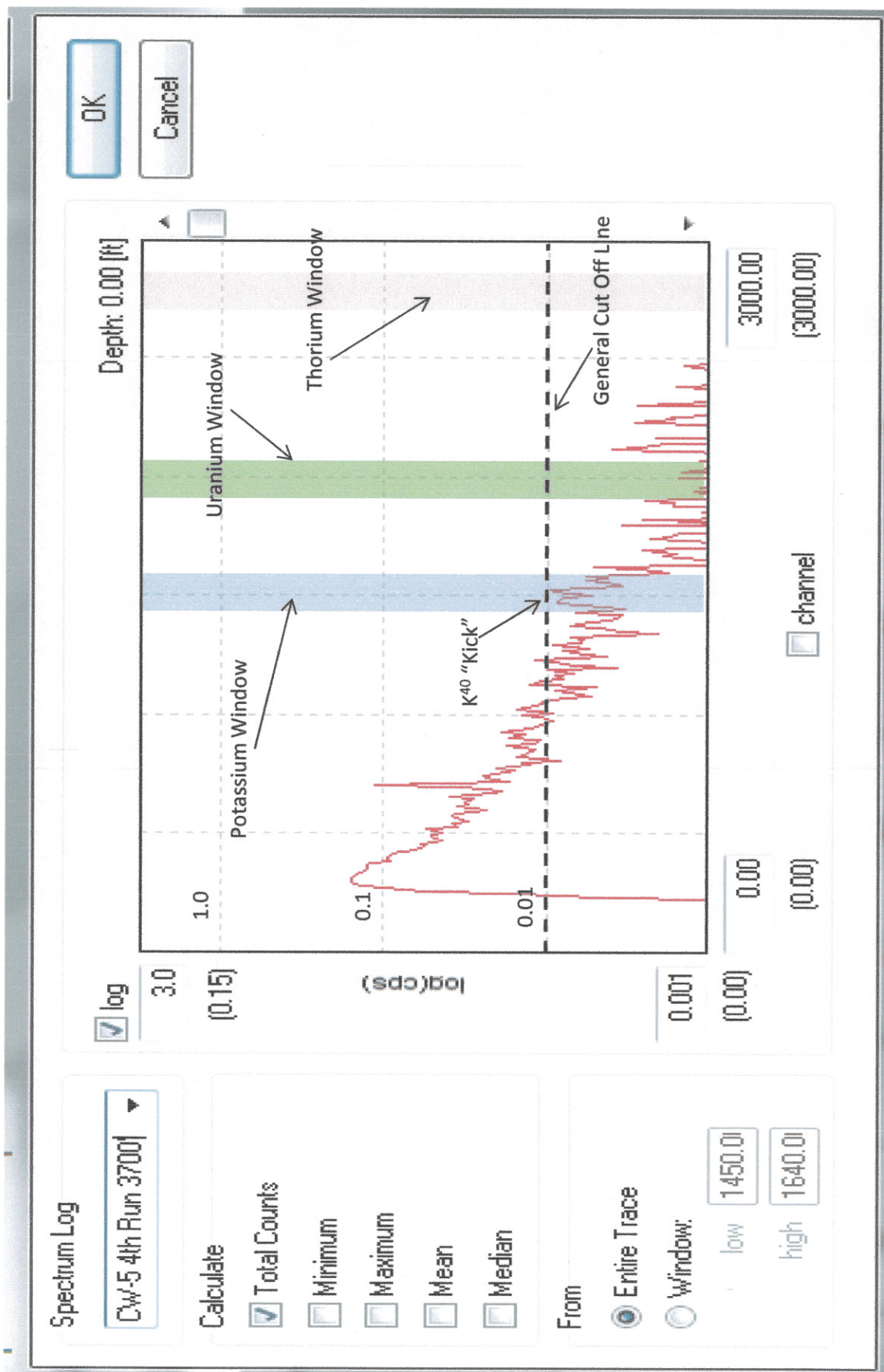




# CW-5 Window at 4056 Feet



# CW-5 Window at 3700 Feet



<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>1. TYPE OF WELL</b> Gas Storage Well	<b>8. WELL NAME and NUMBER:</b> CW-5	
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC	<b>9. API NUMBER:</b> 43027500020000	
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	<b>PHONE NUMBER:</b> 801 993-7001 Ext	<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>COUNTY:</b> MILLARD
		<b>STATE:</b> UTAH

11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

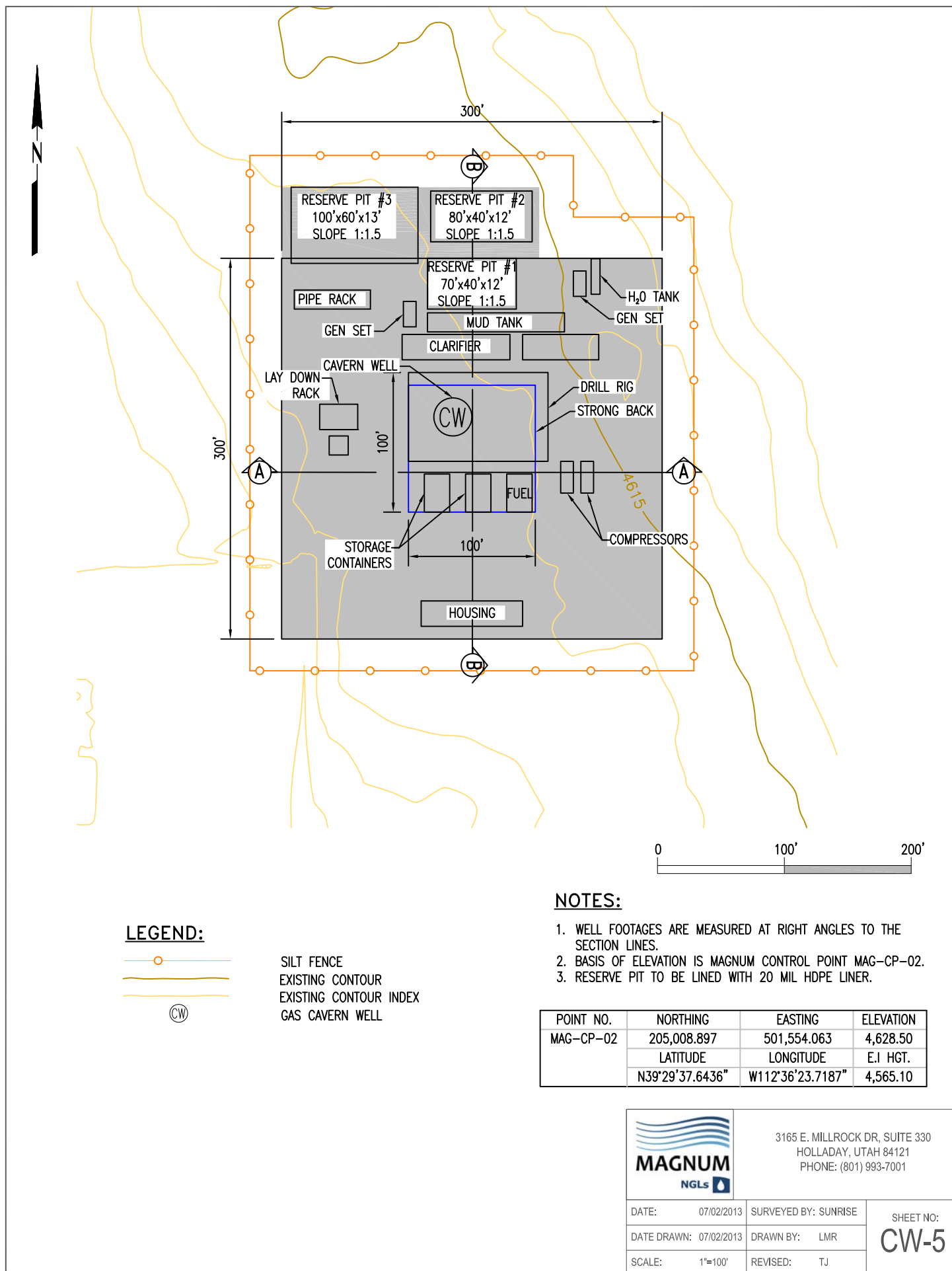
TYPE OF SUBMISSION	TYPE OF ACTION			
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION	<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 5/21/2013  <input type="checkbox"/> SPUD REPORT Date of Spud:  <input type="checkbox"/> DRILLING REPORT Report Date:
	<input checked="" type="checkbox"/> OTHER	OTHER: <u>Construct Additional Reserve</u>		

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum expanded the cavern pad footprint for Cavern Well 5. The expansion was done to accommodate the construct of two additional reserve pits for in situ disposal and mitigation of drilling mud/cuttings (per DOGM's October 18, 2012 Notice to Oil and Gas and Disposal Facility Operators Regarding Drilling Mud and Drill Cuttings). The additional pits are located directly adjacent to the northern edge of the original pad footprint (see attached revised cavern pad design).

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 November 20, 2013

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A		<b>DATE</b> 7/3/2013



## EXHIBIT B: MAGNUM CAVERN WELL 5 WELL PAD

RECEIVED: Jul. 03, 2013



<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input type="checkbox"/> ALTER CASING <input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> DEEPEN <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> PLUG BACK <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> SI TA STATUS EXTENSION <input type="checkbox"/> WILDCAT WELL DETERMINATION	
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 11/30/2013	<input checked="" type="checkbox"/> OTHER	
<input type="checkbox"/> SPUD REPORT Date of Spud:	OTHER: Monthly Report-November 2	
<input type="checkbox"/> DRILLING REPORT Report Date:		
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. Magnum Cavern Well #CW-5 (APD #4838 - API Well No. 430275000 20000) Monthly Status Report for November, 2013. All activities were performed in direct accordance with project specifications and the Utah DOGM and DWQ permits requirements. Activities completed include: - Drilling was completed on September 28, 2013; - Mechanical Integrity Test (MIT) completed October 8-11, 2013; - System testing and the start of solution mining October 13-25, 2013; - Continuation of solution mining at an average rate of 2500 gpm; - Open volume of the cavern by month's end is approximately 245,000 mbbls.		
Accepted by the Utah Division of Oil, Gas and Mining <b>FOR RECORD ONLY</b> January 08, 2014		
<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 12/10/2013	

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>1. TYPE OF WELL</b> Gas Storage Well	<b>8. WELL NAME and NUMBER:</b> CW-5	
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC	<b>9. API NUMBER:</b> 43027500020000	
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	<b>PHONE NUMBER:</b> 801 993-7001 Ext	<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S	<b>COUNTY:</b> MILLARD	
		<b>STATE:</b> UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION		
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION  <input checked="" type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION  OTHER: <u>Monthly Report-December 2</u>
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 12/31/2013			
<input type="checkbox"/> SPUD REPORT Date of Spud:			
<input type="checkbox"/> DRILLING REPORT Report Date:			

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum Cavern Well #CW-5 (APD #4843 - API Well No 430275000 20000) Monthly Status Report for December 2013. Solution mining of CW-5 continued this month. Open cavern volume by month's end is approximately 475,352 bbls. Support activities include the completion of a nitrogen-brine interface test on December 12, 2013 and the scheduling of an early January sonar survey. All activities were performed in direct accordance with project specifications and the Utah DOGM and DWQ permit requirements.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 January 10, 2014

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A		<b>DATE</b> 1/9/2014

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		5. LEASE DESIGNATION AND SERIAL NUMBER: 51573-OBA
		6. IF INDIAN, ALLOTTEE OR TRIBE NAME:
1. TYPE OF WELL Gas Storage Well		7. UNIT or CA AGREEMENT NAME:
2. NAME OF OPERATOR: MAGNUM NGLS SOLUTION MINING LLC		8. WELL NAME and NUMBER: CW-5
3. ADDRESS OF OPERATOR: 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		9. API NUMBER: 43027500020000
4. LOCATION OF WELL FOOTAGES AT SURFACE: 0147 FSL 0167 FWL QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		9. FIELD and POOL or WILDCAT: UNDESIGNATED
		COUNTY: MILLARD
		STATE: UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION			
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION	<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 1/31/2014  <input type="checkbox"/> SPUD REPORT Date of Spud:  <input type="checkbox"/> DRILLING REPORT Report Date:
	<input type="checkbox"/> WILDCAT WELL DETERMINATION	<input checked="" type="checkbox"/> OTHER	OTHER: <u>Monthly Report-January 201</u>	

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum Cavern Well # CW-5 (APD #4843 - API Well NO 430275000 20000) Monthly Status Report for January 2014: Solution mining of CW-5 continue this month. Open cavern volume by month's end is approximately 850,610 bbls. Support activities this month include the completion of a sonar survey on January 15, 2014 to verify the open volume of the storage cavern. All activities were performed in accordance with the project specifications and the Utah DOGM and DWQ permit requirements.

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 February 07, 2014

NAME (PLEASE PRINT) Tiffany A. James	PHONE NUMBER 801 993-7001	TITLE Vice President Project Development
SIGNATURE N/A		DATE 2/7/2014

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE	
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 4/30/2014	<input type="checkbox"/> ALTER CASING	
<input type="checkbox"/> SPUD REPORT Date of Spud:	<input type="checkbox"/> CASING REPAIR	
<input type="checkbox"/> DRILLING REPORT Report Date:	<input type="checkbox"/> CHANGE TO PREVIOUS PLANS	
	<input type="checkbox"/> CHANGE WELL STATUS	
	<input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS	
	<input type="checkbox"/> CONVERT WELL TYPE	
	<input type="checkbox"/> DEEPEN	
	<input type="checkbox"/> FRACTURE TREAT	
	<input type="checkbox"/> NEW CONSTRUCTION	
	<input type="checkbox"/> OPERATOR CHANGE	
	<input type="checkbox"/> PLUG AND ABANDON	
	<input type="checkbox"/> PLUG BACK	
	<input type="checkbox"/> PRODUCTION START OR RESUME	
	<input type="checkbox"/> RECLAMATION OF WELL SITE	
	<input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION	
	<input type="checkbox"/> REPERFORATE CURRENT FORMATION	
	<input type="checkbox"/> SIDETRACK TO REPAIR WELL	
	<input type="checkbox"/> TEMPORARY ABANDON	
	<input type="checkbox"/> TUBING REPAIR	
	<input type="checkbox"/> VENT OR FLARE	
	<input type="checkbox"/> WATER DISPOSAL	
	<input type="checkbox"/> WATER SHUTOFF	
	<input type="checkbox"/> SI TA STATUS EXTENSION	
	<input type="checkbox"/> WILDCAT WELL DETERMINATION	
	<input checked="" type="checkbox"/> OTHER	
	OTHER: <span style="border: 1px solid black; padding: 2px;">Feb-April Period Report</span>	
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. <div style="display: flex; justify-content: space-between;"> <div style="width: 70%;"> <p>Magnum Cavern Well # CW-5 (APD # 4843- API Well No 43027500020000) Period Status Report for February - April 2014. Solution mining of CW-5 continued this period until March 26, 2014. At that time the well was shut in and prepared for the final Mechanical Integrity Test (MIT) required by the Division of Water Quality prior to being placed in service. A sonar survey of the well was completed on March 28, 2014 to verify the open volume of the well. Test results indicate the estimated volume at 1,323,000 barrels. Preparation for the final MIT is still on-going.</p> </div> <div style="width: 25%; text-align: center;"> <p><b>Accepted by the Utah Division of Oil, Gas and Mining</b></p> <p><b>FOR RECORD ONLY</b></p> <p>May 01, 2014</p> </div> </div>		
<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 4/30/2014	

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 993-7001 Ext		<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

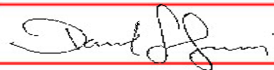
TYPE OF SUBMISSION	TYPE OF ACTION
<input checked="" type="checkbox"/> <b>NOTICE OF INTENT</b> Approximate date work will start: <b>10/29/2014</b>	<div style="display: flex; flex-wrap: wrap;"> <div style="width: 33%;"><input type="checkbox"/> ACIDIZE</div> <div style="width: 33%;"><input type="checkbox"/> ALTER CASING</div> <div style="width: 33%;"><input type="checkbox"/> CASING REPAIR</div> <div style="width: 33%;"><input type="checkbox"/> CHANGE TO PREVIOUS PLANS</div> <div style="width: 33%;"><input type="checkbox"/> CHANGE TUBING</div> <div style="width: 33%;"><input type="checkbox"/> CHANGE WELL NAME</div> <div style="width: 33%;"><input type="checkbox"/> CHANGE WELL STATUS</div> <div style="width: 33%;"><input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS</div> <div style="width: 33%;"><input type="checkbox"/> CONVERT WELL TYPE</div> <div style="width: 33%;"><input type="checkbox"/> DEEPEN</div> <div style="width: 33%;"><input type="checkbox"/> FRACTURE TREAT</div> <div style="width: 33%;"><input type="checkbox"/> NEW CONSTRUCTION</div> <div style="width: 33%;"><input type="checkbox"/> OPERATOR CHANGE</div> <div style="width: 33%;"><input type="checkbox"/> PLUG AND ABANDON</div> <div style="width: 33%;"><input type="checkbox"/> PLUG BACK</div> <div style="width: 33%;"><input type="checkbox"/> PRODUCTION START OR RESUME</div> <div style="width: 33%;"><input type="checkbox"/> RECLAMATION OF WELL SITE</div> <div style="width: 33%;"><input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION</div> <div style="width: 33%;"><input type="checkbox"/> REPERFORATE CURRENT FORMATION</div> <div style="width: 33%;"><input type="checkbox"/> SIDETRACK TO REPAIR WELL</div> <div style="width: 33%;"><input type="checkbox"/> TEMPORARY ABANDON</div> <div style="width: 33%;"><input type="checkbox"/> TUBING REPAIR</div> <div style="width: 33%;"><input type="checkbox"/> VENT OR FLARE</div> <div style="width: 33%;"><input type="checkbox"/> WATER DISPOSAL</div> <div style="width: 33%;"><input type="checkbox"/> WATER SHUTOFF</div> <div style="width: 33%;"><input type="checkbox"/> SI TA STATUS EXTENSION</div> <div style="width: 33%;"><input type="checkbox"/> APD EXTENSION</div> <div style="width: 33%;"><input type="checkbox"/> WILDCAT WELL DETERMINATION</div> <div style="width: 33%;"><input type="checkbox"/> OTHER</div> </div>
<input type="checkbox"/> <b>SUBSEQUENT REPORT</b> Date of Work Completion:	
<input type="checkbox"/> <b>SPUD REPORT</b> Date of Spud:	
<input type="checkbox"/> <b>DRILLING REPORT</b> Report Date:	
<input type="checkbox"/> <b>OTHER:</b> <span style="border: 1px solid black; display: inline-block; width: 150px; height: 20px; vertical-align: middle;"></span>	

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum is requesting to postpone final reclamation of the last CW-5 mud pit. The reason for the requested postponement is to allow for the use of the pit during additional solution mining of storage space in CW-5 within the next 12 months. At this time, Magnum proposes to partially close the pit the last of the three CW-5 mud pits. The barbed wire fence will be re-installed around the open portion of the pit. Then once solution mining is completed, Magnum will pump any remaining brine from the pit, dry the remaining solids, and reclaim the pit per DOGM and SITLA standards

**Approved by the**  
**October 30, 2014**  
**Oil, Gas and Mining**

Date: \_\_\_\_\_

By: 

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A	<b>DATE</b> 10/29/2014	

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		FORM 9
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>1. TYPE OF WELL</b> Gas Storage Well	<b>8. WELL NAME and NUMBER:</b> CW-5	
<b>2. NAME OF OPERATOR:</b> MAGNUM NGLS SOLUTION MINING LLC	<b>9. API NUMBER:</b> 43027500020000	
<b>3. ADDRESS OF OPERATOR:</b> 3165 East Millrock Drive Suite 330 , Holladay, UT, 84121	<b>PHONE NUMBER:</b> 801 993-7001 Ext	<b>9. FIELD and POOL or WILDCAT:</b> UNDESIGNATED
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>COUNTY:</b> MILLARD
		<b>STATE:</b> UTAH

11.

CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION		
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE  <input type="checkbox"/> CHANGE TO PREVIOUS PLANS  <input type="checkbox"/> CHANGE WELL STATUS  <input type="checkbox"/> DEEPEN  <input type="checkbox"/> OPERATOR CHANGE  <input type="checkbox"/> PRODUCTION START OR RESUME  <input type="checkbox"/> REPERFORATE CURRENT FORMATION  <input type="checkbox"/> TUBING REPAIR  <input type="checkbox"/> WATER SHUTOFF  <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING  <input type="checkbox"/> CHANGE TUBING  <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS  <input type="checkbox"/> FRACTURE TREAT  <input type="checkbox"/> PLUG AND ABANDON  <input type="checkbox"/> RECLAMATION OF WELL SITE  <input type="checkbox"/> SIDETRACK TO REPAIR WELL  <input type="checkbox"/> VENT OR FLARE  <input type="checkbox"/> SI TA STATUS EXTENSION  <input checked="" type="checkbox"/> OTHER	<input type="checkbox"/> CASING REPAIR  <input type="checkbox"/> CHANGE WELL NAME  <input type="checkbox"/> CONVERT WELL TYPE  <input type="checkbox"/> NEW CONSTRUCTION  <input type="checkbox"/> PLUG BACK  <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION  <input type="checkbox"/> TEMPORARY ABANDON  <input type="checkbox"/> WATER DISPOSAL  <input type="checkbox"/> APD EXTENSION  OTHER: <span style="border: 1px solid black; padding: 2px;">CW-5 As-Built Casing Design</span>
<input type="checkbox"/> SPUD REPORT Date of Spud:			
<input type="checkbox"/> DRILLING REPORT Report Date:			

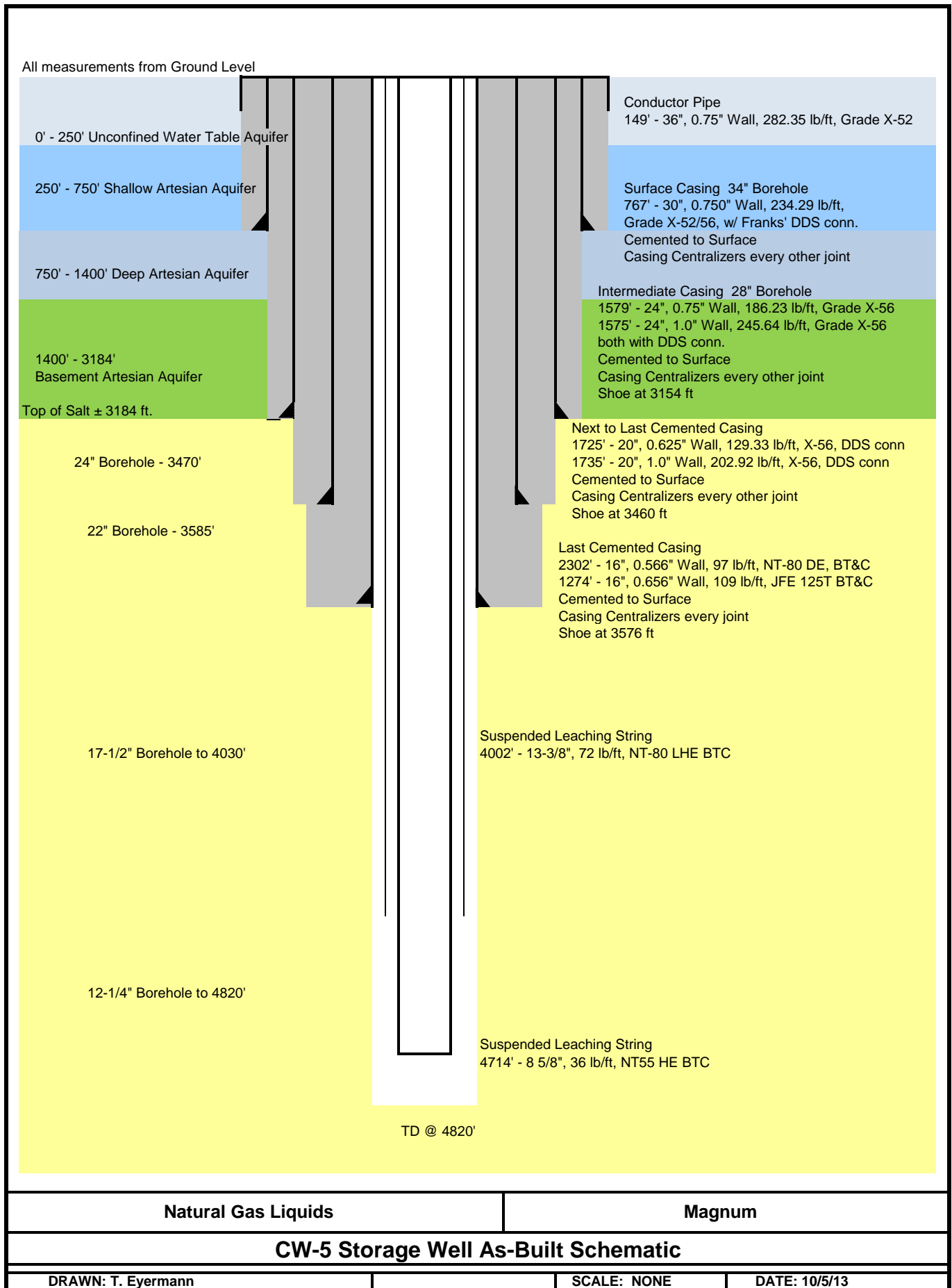
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Magnum NGLS Cavern Well# CW-5 As-Built Casing Design Dated  
 October 5, 2013 API No. 43027500020000 APD No. 4838

**Accepted by the**  
**Utah Division of**  
**Oil, Gas and Mining**  
**FOR RECORD ONLY**  
 February 11, 2015

<b>NAME (PLEASE PRINT)</b> Tiffany A. James	<b>PHONE NUMBER</b> 801 993-7001	<b>TITLE</b> Vice President Project Development
<b>SIGNATURE</b> N/A		<b>DATE</b> 2/2/2015





## Division of Oil, Gas and Mining

## Operator Change/Name Change Worksheet-for State use only

Effective Date: 2/17/2015

<b>FORMER OPERATOR:</b>	<b>NEW OPERATOR:</b>
Magnum NGLs Solutions Mining, LLC N3995 6965 Union Park Avenue, Suite 27 Midval, UT 84047 801-255-9632	NGL Supply Terminal Solution Mining, LLC N4245 6965 Union Park Avenue, Suite 27 Midval, UT 84047 801-255-9632
<b>CA Number(s):</b>	<b>Unit(s):</b>

**WELL INFORMATION:**

Well Name	Sec	TWN	RNG	API	Entity	Mineral	Surface	Type	Status
CW-6	26	150S	070W	4302750003	19132	State	State	GS	A
CW-7	23	150S	070W	4302750004	19669	State	State	GS	A
CW-8	23	150S	070W	4302750005		State	State	GS	DRL
CW-9	26	150S	070W	4302750006		State	State	GS	DRL
CW-5	23	150S	070W	4302750002	19046	State	State	GS	I

**OPERATOR CHANGES DOCUMENTATION:**

1. Sundry or legal documentation was received from the **FORMER** operator on: 4/20/2015
2. Sundry or legal documentation was received from the **NEW** operator on: 4/20/2015
3. New operator Division of Corporations Business Number: 8615504-0160

**REVIEW:**

1. Surface Agreement Sundry from **NEW** operator on Fee Surface wells received on: 4/20/2015
2. Receipt of Acceptance of Drilling Procedures for APD on: 4/20/2015
3. Reports current for Production/Disposition & Sundries: 7/2/2015
4. OPS/SI/TA well(s) reviewed for full cost bonding: 7/2/2015
5. UIC5 on all disposal/injection/storage well(s) approved on: 4/28/2015
6. Surface Facility(s) included in operator change: N/A
7. Inspections of PA state/fee well sites complete on (only upon operators request): N/A

**NEW OPERATOR BOND VERIFICATION:**

1. Federal well(s) covered by Bond Number: N/A
2. Indian well(s) covered by Bond Number: N/A
3. State/fee well(s) covered by Bond Number(s): B009096a

**DATA ENTRY:**

1. Well(s) update in the **OGIS** on: 7/2/2015
2. Entity Number(s) updated in **OGIS** on: 7/2/2015
3. Unit(s) operator number update in **OGIS** on: N/A
4. Surface Facilities update in **OGIS** on: N/A
5. State/Fee well(s) attached to bond(s) in **RBDMS** on: 7/2/2015
6. Surface Facilities update in **RBDMS** on: N/A

**LEASE INTEREST OWNER NOTIFICATION:**

1. The **NEW** operator of the Fee (Mineral) wells has been contacted and informed by a letter from the Division of their responsibility to notify all interest owners of this change on: N/A

**COMMENTS:**

7/2/2015

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

FORM 9

**SUNDRY NOTICES AND REPORTS ON WELLS**

Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.

5. LEASE DESIGNATION AND SERIAL NUMBER:

ML-51573.A-OBA

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

7. UNIT or CA AGREEMENT NAME:

8. WELL NAME and NUMBER:

CW-5

9. API NUMBER:

4302750002

10. FIELD AND POOL, OR WILDCAT:

Undesignated

1. TYPE OF WELL

OIL WELL ☐

GAS WELL ☐

OTHER Gas Storage Wells

2. NAME OF OPERATOR:

NGL Supply Terminal Solution Mining, LLC

3. ADDRESS OF OPERATOR:

6965 Union Park Ave. Ste 27 CITY Midvale

STATE UT

ZIP 84047

PHONE NUMBER:

(801) 255-9632

4. LOCATION OF WELL

FOOTAGES AT SURFACE: 0147 FSL 0167 FWL

COUNTY: Millard County

QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN: SWSW 23 15S 7 W S

STATE:

UTAH

11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION

TYPE OF ACTION

☐ NOTICE OF INTENT  
(Submit in Duplicate)

Approximate date work will start:

☒ SUBSEQUENT REPORT  
(Submit Original Form Only)

Date of work completion:

2/17/2015

☐ ACIDIZE

☐ ALTER CASING

☐ CASING REPAIR

☐ CHANGE TO PREVIOUS PLANS

☐ CHANGE TUBING

☐ CHANGE WELL NAME

☐ CHANGE WELL STATUS

☐ COMINGLE PRODUCING FORMATIONS

☐ CONVERT WELL TYPE

☐ DEEPEN

☐ FRACTURE TREAT

☐ NEW CONSTRUCTION

☒ OPERATOR CHANGE

☐ PLUG AND ABANDON

☐ PLUG BACK

☐ PRODUCTION (START/RESUME)

☐ RECLAMATION OF WELL SITE

☐ RECOMPLETE - DIFFERENT FORMATION

☐ REPERFORATE CURRENT FORMATION

☐ SIDETRACK TO REPAIR WELL

☐ TEMPORARILY ABANDON

☐ TUBING REPAIR

☐ VENT OR FLARE

☐ WATER DISPOSAL

☐ WATER SHUT-OFF

☒ OTHER: Operator name change

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.

Change of Operator name from Magnum NGLs Solution Mining, LLC to NGL Supply Terminal Solution Mining, LLC effective 2/17/2015

Operator current name:

Magnum NGLs Solution Mining, LLC, 3165 E Millrock Drive, Suite 330, Holladay, Utah 84121 801-993-7001

Operator new name and address:

NGL Supply Terminal Solution Mining, LLC, 6965 Union Park Avenue, Suite 270 Midvale, Utah 84047 801-255-9632

Wells are under State bond number B009096.

Existing lease. Memorandum of Natural Gas Liquid Storage Lease #ML-51573.A-OBA remains in effect.

See attached list of additional included wells (CW-5, CW-6, CW-7, CW-8, CW-9)

NAME (PLEASE PRINT)

Adam Richins

TITLE

Safety, Compliance & Regulatory Manager

SIGNATURE

*Adam Richins*

DATE

4/20/2015

(This space for State use only)

**APPROVED**

JUL 02 2015

DIV. OIL GAS & MINING

BY: *Rachael Medina*

### List of Cavern Wells (Magnum NGLs/Sawtooth)

Well Name	Section	Township	Range	API Number	Entity Number	Mineral Lease Type	Well Type
CW-5	23	15 S	7 W	43-027-50002	N/A	State	Gas Storage Well
CW-6	26	15 S	7 W	43-027-50003	N/A	State	Gas Storage Well
CW-7	23	15 S	7 W	43-027-50004	N/A	State	Gas Storage Well
CW-8	23	15 S	7 W	43-027-50005	N/A	State	Gas Storage Well
CW-9	26	15 S	7 W	43-027-50006	N/A	State	Gas Storage Well

<b>ooth)</b>
<b>Well Status</b>
Inactive
Active
Active
Spudded (Drilling commenced: Not yet completed)
New Permit (Not yet approved or drilled)

# Delaware

PAGE 1

*The First State*

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF AMENDMENT OF "MAGNUM NGLS, LLC", CHANGING ITS NAME FROM "MAGNUM NGLS, LLC" TO "SAWTOOTH NGL CAVERNS, LLC", FILED IN THIS OFFICE ON THE EIGHTEENTH DAY OF MARCH, A.D. 2015, AT 12:21 O'CLOCK P.M.

5037140 8100

150374000

You may verify this certificate online  
at [corp.delaware.gov/authver.shtml](http://corp.delaware.gov/authver.shtml)



  
Jeffrey W. Bullock, Secretary of State  
AUTHENTICATION: 2211843

DATE: 03-18-15



## STATE OF DELAWARE CERTIFICATE OF AMENDMENT

1. Name of Limited Liability Company: MAGNUM NGLS, LLC
2. The Certificate of Formation of the limited liability company is hereby amended as follows:

1. The name of the Limited Liability Company is  
Sawtooth NGL Caverns, LLC.

IN WITNESS WHEREOF, the undersigned have executed this Certificate on  
the 17th day of March, A.D. 2015.

By:   
Authorized Person(s)

Name: William G. Laughlin

Print or Type

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

**Request to Transfer Application or Permit to Drill**

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

<b>Well name:</b>	CW-5
<b>API number:</b>	430275002
<b>Location:</b>	Qtr-Qtr: SWSW Section: 23 Township: 15 S Range: 7 W
<b>Company that filed original application:</b>	Magnum NGLs Solution Mining, LLC
<b>Date original permit was issued:</b>	05/02/2013
<b>Company that permit was issued to:</b>	Magnum NGLs Solution Mining, LLC

Check one	Desired Action:
<input type="checkbox"/>	Transfer pending (unapproved) Application for Permit to Drill to new operator
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	Transfer approved Application for Permit to Drill to new operator
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.	Yes	No
If located on private land, has the ownership changed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> If so, has the surface agreement been updated?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Has the approved source of water for drilling changed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Is bonding still in place, which covers this proposed well? Bond No. B009096	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Adam Richins

Title Safety, Compliance and Regulatory Manager

Signature 

Date 04/20/2015

Representing (company name) NGL Supply Terminal Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill.

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

UIC FORM 5

TRANSFER OF AUTHORITY TO INJECT

Well Name and Number CW-5	API Number 4302750002
Location of Well Footage: 147 S 167 W County: Millard County QQ. Section. Township. Range: SWSW 23 15S 7W State: UTAH	Field or Unit Name Lease Designation and Number State ML-51573.A-OBA

EFFECTIVE DATE OF TRANSFER: 2/17/2015

CURRENT OPERATOR

Company: Magnum NGLs Solution Mining. LLC Name: Adam Richins  
Address: 3165 E Millrock Drive Suite 330 Signature: *Adam Richins*  
city Holladay state UT zip 84121 Title: Safety. Compliance & Regulatory Manager  
Phone: (801) 993-7001 Date: 4-20-15  
Comments: Entity is the same. Name of operator is changing.

NEW OPERATOR

Company: NGL Supply Terminal Solution Mining. LLC Name: Adam Richins  
Address: 6965 Union Park Avenue Suite 270 Signature: *Adam Richins*  
city Midvale state UT zip 84047 Title: Safety. Compliance & Regulatory Manager  
Phone: (801) 255-9632 Date: 4-20-15  
Comments: Magnum NGLs Solution Mining. LLC is changing name to NGL Supply Terminal Solution Mining. LLC

(This space for State use only)

Transfer approved by: *[Signature]*

Title: *Geologist*

Approval Date: 4/28/15

Comments:

RECEIVED

APR 2014

Div. of Oil, Gas & Mining

**STATE OF UTAH**  
**DEPARTMENT OF NATURAL RESOURCES**  
**DIVISION OF OIL, GAS AND MINING**

**Request to Transfer Application or Permit to Drill**

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

<b>Well name:</b>	CW-6
<b>API number:</b>	430275003
<b>Location:</b>	Qtr-Qtr: NWNW Section: 26 Township 15 S Range: 7 W
<b>Company that filed original application:</b>	Magnum NGLs Solution Mining, LLC
<b>Date original permit was issued:</b>	05/02/2013
<b>Company that permit was issued to:</b>	Magnum NGLs Solution Mining, LLC

<b>Check one</b>	<b>Desired Action:</b>
<input type="checkbox"/>	
<input type="checkbox"/>	<b>Transfer pending (unapproved) Application for Permit to Drill to new operator</b>
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	<b>Transfer approved Application for Permit to Drill to new operator</b>
<input type="checkbox"/>	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.		Yes	No
If located on private land, has the ownership changed?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	If so, has the surface agreement been updated?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Has the approved source of water for drilling changed?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?		<input type="checkbox"/>	<input checked="" type="checkbox"/>
Is bonding still in place, which covers this proposed well? Bond No. <u>B009096</u>		<input checked="" type="checkbox"/>	<input type="checkbox"/>

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Adam Richins Title Safety, Compliance and Regulatory Manager  
Signature *Adam Richins* Date 04/20/2015  
Representing (company name) NGL Supply Terminal Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill.

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

UIC FORM 5

TRANSFER OF AUTHORITY TO INJECT

Well Name and Number <b>CW-6</b>	API Number <b>4302750003</b>
Location of Well Footage: <b>442 N 284 W</b> County: <b>Millard County</b> QQ. Section. Township. Range: <b>NWNW 26 15S 7W</b> State: <b>UTAH</b>	Field or Unit Name Lease Designation and Number <b>State ML-51573.A-OBA</b>

EFFECTIVE DATE OF TRANSFER: 2/17/2015

CURRENT OPERATOR

Company: <u>Magnum NGLs Solution Mining. LLC</u>	Name: <u>Adam Richins</u>
Address: <u>3165 E Millrock Drive Suite 330</u>	Signature: <u><i>Adam Richins</i></u>
<u>city</u> <u>Holladay</u> <u>state</u> <u>UT</u> <u>zip</u> <u>84121</u>	Title: <u>Safety. Compliance &amp; Regulatory Manager</u>
Phone: <u>(801) 993-7001</u>	Date: <u>4-20-15</u>
Comments: Entity is the same. Name of operator is changing.	

NEW OPERATOR

Company: <u>NGL Supply Terminal Solution Mining. LLC</u>	Name: <u>Adam Richins</u>
Address: <u>6965 Union Park Avenue Suite 270</u>	Signature: <u><i>Adam Richins</i></u>
<u>city</u> <u>Midvale</u> <u>state</u> <u>UT</u> <u>zip</u> <u>84047</u>	Title: <u>Safety. Compliance &amp; Regulatory Manager</u>
Phone: <u>(801) 255-9632</u>	Date: <u>4-20-15</u>
Comments: <u>Magnum NGLs Solution Mining. LLC is changing name to NGL Supply Terminal Solution Mining. LLC</u>	

(This space for State use only)

Transfer approved by: EPA  
Title: \_\_\_\_\_

Approval Date: \_\_\_\_\_

Comments:

RECEIVED

APR 22 2014

Div. of Oil, Gas & Mining

**STATE OF UTAH**  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

**Request to Transfer Application or Permit to Drill**

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

<b>Well name:</b>	CW-7
<b>API number:</b>	430275004
<b>Location:</b>	Qtr-Qtr: SWSW Section: 23 Township: 15 S Range: 7 W
<b>Company that filed original application:</b>	Magnum NGLs Solution Mining, LLC
<b>Date original permit was issued:</b>	02/11/2014
<b>Company that permit was issued to:</b>	Magnum NGLs Solution Mining, LLC

Check one	Desired Action:
	<b>Transfer pending (unapproved) Application for Permit to Drill to new operator</b>
	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	<b>Transfer approved Application for Permit to Drill to new operator</b>
	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.	Yes	No
If located on private land, has the ownership changed?		<input checked="" type="checkbox"/>
<input type="checkbox"/> If so, has the surface agreement been updated?		<input checked="" type="checkbox"/>
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?		<input checked="" type="checkbox"/>
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?		<input checked="" type="checkbox"/>
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?		<input checked="" type="checkbox"/>
Has the approved source of water for drilling changed?		<input checked="" type="checkbox"/>
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?		<input checked="" type="checkbox"/>
Is bonding still in place, which covers this proposed well? Bond No. <u>B009096</u>	<input checked="" type="checkbox"/>	

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Adam Richins Title Safety, Compliance and Regulatory Manager  
Signature *Adam Richins* Date 04/20/2015  
Representing (company name) NGL Supply Terminal Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill.



STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

UIC FORM 5

TRANSFER OF AUTHORITY TO INJECT

Well Name and Number CW-7	API Number 4302750004
Location of Well Footage : 852 S 91 W County : Millard County QQ. Section. Township. Range: SWSW 23 15S 7W State : UTAH	Field or Unit Name Lease Designation and Number State ML-51573.A-OBA

EFFECTIVE DATE OF TRANSFER: 2/17/2015

CURRENT OPERATOR

Company: Magnum NGLs Solution Mining, LLC	Name: Adam Richins
Address: 3165 E Millrock Drive Suite 330	Signature: <i>Adam Richins</i>
city Holladay state UT zip 84121	Title: Safety, Compliance & Regulatory Manager
Phone: (801) 993-7001	Date: 4-20-15
Comments: Entity is the same. Name of operator is changing.	

NEW OPERATOR

Company: NGL Supply Terminal Solution Mining, LLC	Name: Adam Richins
Address: 6965 Union Park Avenue Suite 270	Signature: <i>Adam Richins</i>
city Midvale state UT zip 84047	Title: Safety, Compliance & Regulatory Manager
Phone: (801) 255-9632	Date: 4-20-15
Comments: Magnum NGLs Solution Mining, LLC is changing name to NGL Supply Terminal Solution Mining, LLC	

(This space for State use only)

Transfer approved by: EPA  
Title: \_\_\_\_\_

Approval Date: \_\_\_\_\_

Comments:

RECEIVED

APR 2014

Div. of Oil, Gas & Mining

**STATE OF UTAH**  
**DEPARTMENT OF NATURAL RESOURCES**  
**DIVISION OF OIL, GAS AND MINING**

**Request to Transfer Application or Permit to Drill**

(This form should accompany a Sundry Notice, Form 9, requesting APD transfer)

<b>Well name:</b>	CW-8
<b>API number:</b>	430275005
<b>Location:</b>	Qtr-Qtr: SWSW Section: 23 Township: 15 S Range: 7 W
<b>Company that filed original application:</b>	Magnum NGLs Solution Mining, LLC
<b>Date original permit was issued:</b>	11/25/2014
<b>Company that permit was issued to:</b>	Magnum NGLs Solution Mining, LLC

<b>Check one</b>	<b>Desired Action:</b>
<input type="checkbox"/>	<b>Transfer pending (unapproved) Application for Permit to Drill to new operator</b>
	The undersigned as owner with legal rights to drill on the property, hereby verifies that the information as submitted in the pending Application for Permit to Drill, remains valid and does not require revision. The new owner of the application accepts and agrees to the information and procedures as stated in the application.
<input checked="" type="checkbox"/>	<b>Transfer approved Application for Permit to Drill to new operator</b>
	The undersigned as owner with legal rights to drill on the property as permitted, hereby verifies that the information as submitted in the previously approved application to drill, remains valid and does not require revision.

Following is a checklist of some items related to the application, which should be verified.		Yes	No
If located on private land, has the ownership changed?			✓
If so, has the surface agreement been updated?			✓
Have any wells been drilled in the vicinity of the proposed well which would affect the spacing or siting requirements for this location?			✓
Have there been any unit or other agreements put in place that could affect the permitting or operation of this proposed well?			✓
Have there been any changes to the access route including ownership or right-of-way, which could affect the proposed location?			✓
Has the approved source of water for drilling changed?			✓
Have there been any physical changes to the surface location or access route which will require a change in plans from what was discussed at the onsite evaluation?			✓
Is bonding still in place, which covers this proposed well? Bond No. <u>B009096</u>		✓	

Any desired or necessary changes to either a pending or approved Application for Permit to Drill that is being transferred, should be filed on a Sundry Notice, Form 9, or amended Application for Permit to Drill, Form 3, as appropriate, with necessary supporting information as required.

Name (please print) Adam Richins Title Safety, Compliance and Regulatory Manager  
Signature *Adam Richins* Date 04/20/2015  
Representing (company name) NGL Supply Terminal Solution Mining, LLC

The person signing this form must have legal authority to represent the company or individual(s) to be listed as the new operator on the Application for Permit to Drill.

STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF OIL, GAS AND MINING

UIC FORM 5

TRANSFER OF AUTHORITY TO INJECT

Well Name and Number CW-8	API Number 4302750005
Location of Well Footage : 805 S 548 W County : Millard County QQ. Section. Township. Range: SWSW 23 15S 7W State : UTAH	Field or Unit Name Lease Designation and Number State ML-51573.A-OBA

EFFECTIVE DATE OF TRANSFER: 2/17/2015

CURRENT OPERATOR

Company: Magnum NGLs Solution Mining. LLC Name: Adam Richins  
Address: 3165 E Millrock Drive Suite 330 Signature: *Adam Richins*  
city Holladay state UT zip 84121 Title: Safety. Compliance & Regulatory Manager  
Phone: (801) 993-7001 Date: 4-20-15  
Comments: Entity is the same. Name of operator is changing.

NEW OPERATOR

Company: NGL Supply Terminal Solution Mining. LLC Name: Adam Richins  
Address: 6965 Union Park Avenue Suite 270 Signature: *Adam Richins*  
city Midvale state UT zip 84047 Title: Safety. Compliance & Regulatory Manager  
Phone: (801) 255-9632 Date: 4-20-15  
Comments: Magnum NGLs Solution Mining. LLC is changing name to NGL Supply Terminal Solution Mining. LLC

(This space for State use only)

Transfer approved by: EPA  
Title: \_\_\_\_\_

Approval Date: \_\_\_\_\_

Comments:

RECEIVED

APR 22 2014

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> NGL SUPPLY TERMINAL SOLUTION MINING, LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 6965 Union Park Avenue, Suite 270, Midvale, UT, 84047		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 255-9632 Ext		<b>9. FIELD and POOL or WILDCAT:</b> DELTA SALT CAVERN STORAGE
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH
11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA		
<b>TYPE OF SUBMISSION</b>	<b>TYPE OF ACTION</b>	
<input type="checkbox"/> NOTICE OF INTENT Approximate date work will start:	<input type="checkbox"/> ACIDIZE <input type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	
<input checked="" type="checkbox"/> SUBSEQUENT REPORT Date of Work Completion: 4/22/2016	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION <input checked="" type="checkbox"/> OTHER	
<input type="checkbox"/> SPUD REPORT Date of Spud:	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION	
<input type="checkbox"/> DRILLING REPORT Report Date:	OTHER: <span style="border: 1px solid black; padding: 2px;">Workover &amp; MIT</span>	
12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc. <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 60%;">           Cavern Well CW-5 Workover and MIT Report (see attached)         </div> <div style="width: 35%; text-align: right;"> <b>Accepted by the Utah Division of Oil, Gas and Mining</b>   <b>Date:</b> <u>May 24, 2016</u>  <b>By:</b> </div> </div>		
<b>NAME (PLEASE PRINT)</b> Adam Richins	<b>PHONE NUMBER</b> 801 255-9632	<b>TITLE</b> Compliance Manager
<b>SIGNATURE</b> N/A	<b>DATE</b> 5/23/2016	



## **Report on NGL Supply Terminal Solution Mining Well CW-5 Pre-Storage Mechanical Integrity Test**

Report SW-2016-05

Prepared for:  
NGL Supply Terminal Solution Mining LLC  
Midvale, Utah

By:  
Thomas Eyermann  
April 23, 2016

Revision 0

## Contents

Background .....	2
Well Nitrogen/Brine MIT .....	3
Well Activities .....	3
Brine Pressurization .....	3
Nitrogen Injection .....	3
Calculations .....	7
Methodology .....	7
Interface Logging .....	7
Nitrogen Mass Calculation .....	8
Calculated Leak Rate .....	9
Minimum Detectable Leak Rate .....	10
Standard Deviation in Well Pressure Measurement Bias .....	10
Standard Deviation in Temperature Measurement Bias .....	11
Interface Depth Measurement Accuracy .....	11
Results and Discussion .....	11
Appendix A Mechanical Integrity Test Procedures .....	12
Appendix B Wellhead Pressures during Well CW-5 MIT .....	22
Appendix C Temperature and Nitrogen Data during Well CW-5 MIT .....	33
Appendix D Calibration Papers for Pressure Recorders .....	51
Appendix E Utah UIC Forms .....	53
Appendix F Interface logs for CW-5 MIT .....	60





CW-5 MIT Rev. 0

## **Report on NGL Supply Terminal Solution Mining Well CW-5 Storage Mechanical Integrity Test**

### **Background**

NGL Supply Terminal Solution Mining LLC (fka Magnum NGL Solution Mining) drilled Well CW-5 into the Delta salt deposit. The well was solution mined to create a storage cavern for natural gas liquids. The well has been in use for butane storage since July 2014. This report describes the mechanical integrity test (MIT) test conducted on the well in April 2016 after completion of a workover to develop a new 16" casing seat and to re-install the 13-3/8" hanging string to allow future mining.

The method used for completing the well MIT was a nitrogen brine interface test of the completed well system. The procedure for the test was submitted to the Division of Water Quality and the Division of Oil, Gas and Mining in April 2016.

The integrity of the casing, wellhead and wellbore in NGL Supply Terminal Solution Mining Well CW-5 had been previously verified in June 2014 by means of a nitrogen brine interface test.

CW-5 was solution mined from October 17, 2103 until March 27, 2014. Following completion of mining, the well was worked over to remove the mining strings and to permit a sonar survey of the entire cavern. The cavern volume at the end of mining was about 1,372,000 barrels and is now about 1,382,000 as measured by sonar survey. The survey covered the entire cavern.

The well was then placed into storage service and operated for about two years. The well was then worked over a second time. This workover was to establish a new 16" casing seat and to re-install the 13-3/8" string to allow future expansion of the cavern. A sonar survey was conducted during the workover.

The 16" casing was mechanically cut at 3,480 feet to reduce the risk that future salt creep would exert stress on the casing nearer to the cavern roof resulting in damage to the cemented casing and possibly loss of integrity. The casing below the cut is still in place, but the cut forms a new, shallower casing seat that will not be damaged by salt creep.

After the sonar survey, the mining strings were run back to about 4,033 feet for the 13-3/8" string and 4,410 for the 8-5/8" string. The bottom joint of the 8-5/8" string has two 1" weepholes located five feet from the bottom of the joint. A schematic of the well is shown in Figure 1.

The well was then tested to ensure mechanical integrity of the new casing seat.



CW-5 MIT Rev. 0

## **Well Nitrogen/Brine MIT**

### ***Well Activities***

To prepare for the test, the wellhead valves were equipped with tapped blind flanges. The flanges were equipped with small valves and pressure gauges to allow monitoring of the pressures during the test. The test procedures and well data are included in Appendix A.

Nitrogen and brine pumping services, including a flow meter, were provided by Cudd Energy Services. Site personnel connected pressure monitoring recorders to calibrated transducers on the wellhead. Wireline services were performed by Jet West Geophysical Services.

### ***Brine Pressurization***

The cavern was prepared for the MIT by injecting brine into the cavern to increase the pressure to that required for the test. Prior to injecting brine, the wellhead piping had been removed and the wellhead valves were capped with blind flanges. A pressure transducer and recorder were attached to the 16" x 13-3/8" annulus and the 13-3/8" x 8-5/8" annulus to monitor the pressure.

Brine injection started on April 10, 2016. Cudd Energy Services pumped field brine into the well on the 16" x 13-3/8" annulus. At the end of brine pumping the wellhead pressure was about 800 psig. The pressurization rate averaged 1.6 psi per minute during brine injection up to 520 psi. The remainder of the pressurization was at a rate of 0.8 psi per minute. The cavern compressibility was 5.4 barrels per psi increase.

The pressure at the wellhead decreased about 10 psi in fourteen hours. The well was shut-in at 8:00 PM on April 10. The well sat idle until April 19 to allow the cavern to stabilize.

The surface brine pressure in the 13-3/8" x 8-5/8" annulus needed to be about 800 psi to achieve the desired test gradient of 0.75 psi per foot of depth at the 16" casing shoe. After completion of brine injection on April 10 the surface brine pressure on the well was 817 psi. The pressure on April 20 before injecting nitrogen was about 789 psi.

### ***Nitrogen Injection***

After connecting equipment to the wellhead on April 19, 2016, Jet West rigged up the wireline tools and ran the baseline temperature log from surface to 4,050 feet in the well. The average wellbore temperature was 86.5° F. Figure 2 shows the temperature logs during the test sequence. Changes between the runs are due to stabilization effects with ground temperature. The baseline density and sonic logs were run from 3,600 to 3,400 feet.

On April 20, Cudd Energy Services rigged up the nitrogen pump and tank trucks. Nitrogen injection was started late morning on April 20. The brine wellhead pressure at the beginning of nitrogen injection was about 789 psig. The nitrogen temperature was controlled at about 85° F (near the average wellbore temperature) to minimize the time required for temperature stabilization.

CW-5 MIT Rev. 0

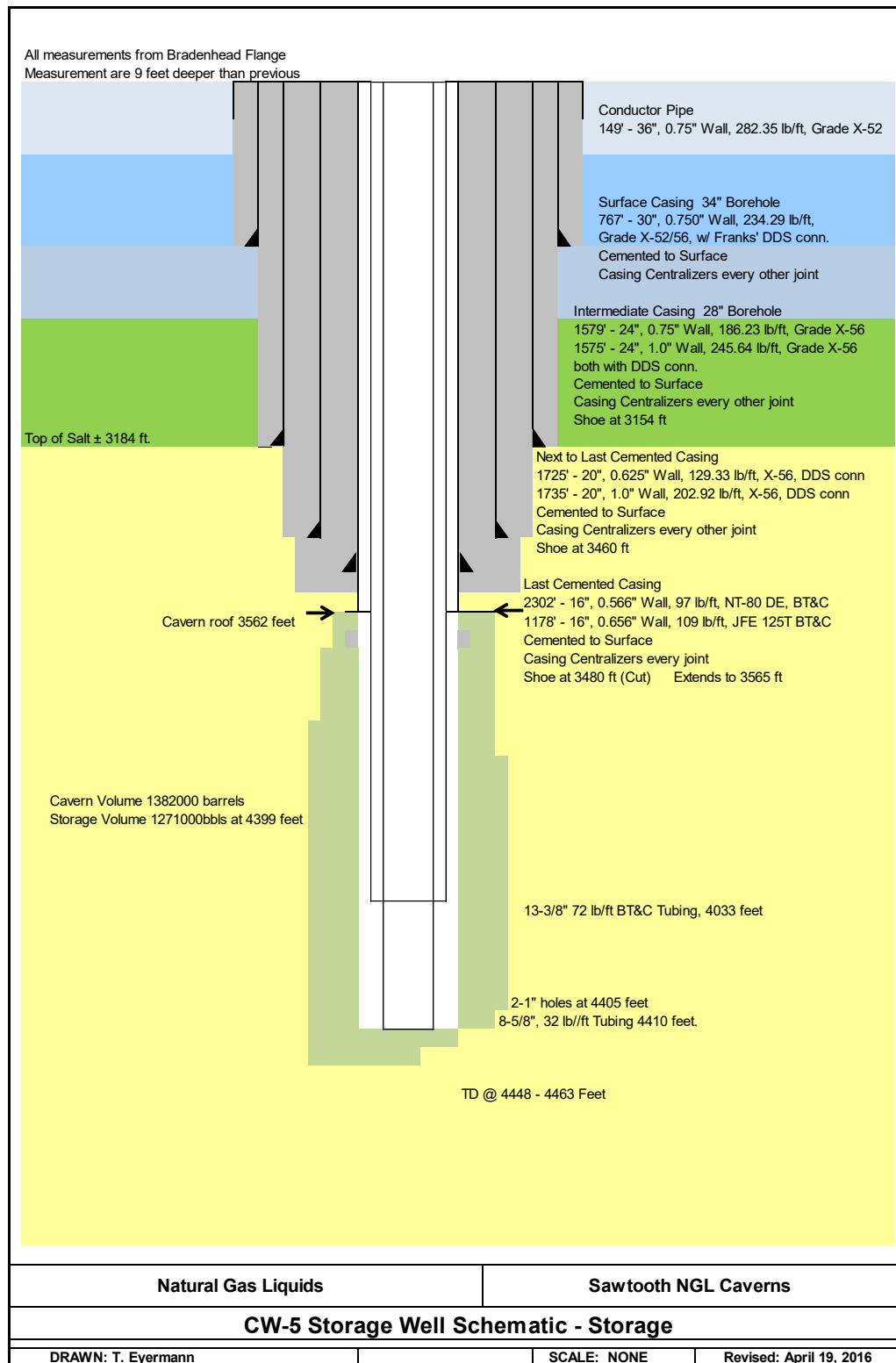


Figure 1 Schematic of Well CW-5 for MIT



CW-5 MIT Rev. 0

Jet West attempted to find the nitrogen after 80,000 scf were injected. This should have placed the nitrogen /brine interface at about 2,750 feet. The interface was found at 2,682 feet. The interface was then followed downhole to 3,312 feet. The one-hour casing test was conducted at 3,312 feet. After one hour the interface was found at 3,3120 feet with a one psi increase in the nitrogen pressure.

Nitrogen injection then continued to about 3,545 feet. Nitrogen injection was stopped with the interface inside the remnant of the 16" casing at the cavern roof. The 16" casing had been cut at 3,480 feet to establish a new casing seat. After allowing the nitrogen to settle for about one half hour, the interface was relogged and found at 3,542 feet.

A total of 125,000 scf of nitrogen were injected into the well. Calculations based on the casing sizes indicated that the well should have about 121,000 scf at the well pressure of 2,290 psi.

The well was shut-in at about 1720 hours on April 20 after pulling the logging tools out of the hole. The pressure recording equipment remained installed and monitoring.

The well was left shut-in until about 0930 April 21, 2016. Jet West then ran into the well with logging tools. A temperature log was run on the trip into the well and the interface was logged afterwards. The interface was found at about 3,554.5 feet, about 13 feet lower than the depth at which it had been spotted the previous day. The change in depth is attributed to separation of a nitrogen/butane emulsion that developed during high rate injection of the nitrogen.

Interface depths and corresponding wellhead pressures measured during the MIT are summarized in Table 1. The pressure on April 22 had increased about four psi since initially spotting the interface on April 20. The wellhead pressures are given in Appendix B.

Another set of logs was run on April 22, about 24 hours after the start of the test. Again the temperature log was run on the way into the well and the interface log was run on the way out. The interface had moved uphole to 3,552 feet since the previous day (Table 2) and the nitrogen pressure had risen one psi. This log was the end of the MIT.

**Table 1 Interfaces and Nitrogen Pressure during Well CW-5 MIT**

<b>Date/Time</b>	<b>Interface Depth – Feet</b>	<b>Wellhead Nitrogen Pressure – psig</b>	<b>Notes</b>
April 20, 2106 1438	3,312.0	2130	End of Casing Test
April 20, 2016 1631	3,541.0	2290	Spot Nitrogen
April 21, 2016 1058	3,554.5	2294	Start Test
April 22, 2016 1015	3,552.0	2295	End Test



CW-5 MIT Rev. 0

## Sawtooth NGL Well CW-5 MIT - April 2016

### Temperature (F)

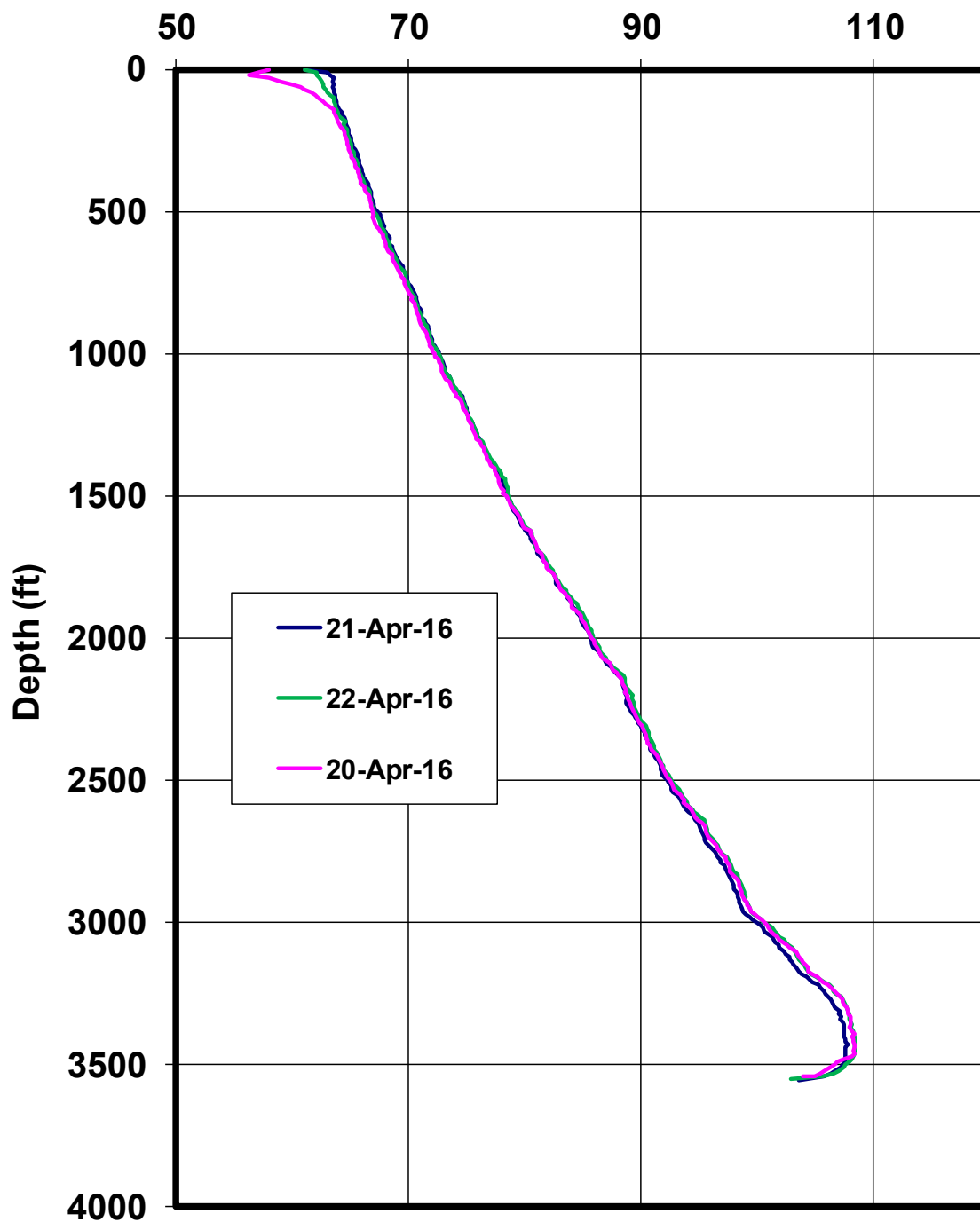


Figure 2 CW-5 Temperatures during April 2016 MIT



CW-5 MIT Rev. 0

## **Calculations**

Using data collected during the test, a minimum detectable leak rate (MDLR) and a calculated nitrogen leak rate (CLR) can be calculated. Calculation of both leak rates requires knowing the pressure and temperature of the nitrogen as well as the depth to the brine/nitrogen interface at the start and end of the test.

## **Methodology**

The purpose of performing this MIT is to determine if the cavern system has mechanical integrity and is, therefore, suitable for the storage of natural gas. The procedure involves continued injection of nitrogen into the storage well to a specified test pressure so that the nitrogen interface is below the production casing. The nitrogen interface depth can be affected by pressure and temperature changes caused by temperature equilibration, salt dissolution, and salt creep effects. In order to distinguish between these effects and nitrogen volume losses caused by leaks, the pressure and temperature changes must be considered. The following discussion and equations are borrowed from a report by Pavan Vajjha, Mark W. Meece, and Joe L. Ratigan, 2007, Mechanical Integrity Test Report Enterprise Products Operating L.P. Wilson Well No. 4, Boling Salt Dome, PB-ESS Report Prepared for Enterprise Products Operating L.P.

The nitrogen pressure, brine pressure, nitrogen temperature and nitrogen/brine interface depth are monitored during the test period. Evaluation of the test results involves calculating the volume of nitrogen to the interface at the start of the test and at the end of the test. Changes in calculated nitrogen volumes over the test period yield an apparent nitrogen volume change. The integrity of the well can be confirmed if the calculated nitrogen volume change is within the accuracy limits of the test method. The annual leak rate can be determined by linear extrapolation of the calculated change in nitrogen volume during the test period.

## **Interface Logging**

Normally, a brine-nitrogen interface MIT uses a density tool to detect the brine-nitrogen interface. Past experience on all the MITs run in the Delta wells has been that while within the 16" casing string, the interface has been difficult or impossible to find with the gamma-gamma, 4Pi, or pulse neutron density tools typically used for MITs. Once below the 16" casing, the standard tools are adequate. The test in CW-5 has the nitrogen/brine interface within 16" casing for the entire test.

To improve the detection of the interface within the 16" casing, a sonic tool, typically used for cement bond evaluation, was utilized. Work in CW-9 showed that the tool clearly finds the interface in the salt shaft below the 16" casing.

Use of the sonic tool in CW-5 indicates that the tool can find the interface between brine and non-brine fluid. However, it is difficult to distinguish between butane and nitrogen. As the pressure in the wellbore increased from the initial 800 psi to 2500 psi as nitrogen was injected, the difference between butane and nitrogen became more easy to distinguish with the sonic tool. The gate for waveform selection was altered to match the signatures at the slightly higher pressures.

CW-5 MIT Rev. 0

On the sonic log, the interface is shown where the five-foot amplitude curve crosses over the three-foot amplitude curve. At this point the amplitude curve becomes irregular. Similarly, the five-foot travel time curve crosses over the three-foot travel time curve and becomes irregular.

During the injection of nitrogen into CW-5, the brine-nitrogen-butane interface could not be found after injecting 30,000 scf of nitrogen. This should have placed the interface at about 1,500 feet. Additional 50,000 scf were injected and the interface was found at 2,682 feet. The sonic log was then able to follow the interface downhole for an additional eight episodes of nitrogen injection, with the detected interface within 100 feet of the estimated depth based on pressure and casing dimensions.

During the various nitrogen injection episodes, it appeared that high rate injection (3,000 scf per minute) resulted in the development of a nitrogen-butane emulsion that settled out within 30 to 60 minutes. (For example at the higher rate injection, the interface moved from about 2,962 to 2,952 feet in one hour during an early attempt at a casing test.) The nitrogen injection rate for the last four episodes of injection covering the last 200 feet of depth in the well was slowed down to about 1,500 scf per minute. At the end of injection, the interface moved from 3,544 feet to 3,541 feet after allowing the well to be static for 30 minutes.

## Nitrogen Mass Calculation

In addition to measured quantity of nitrogen, information of the well casing, tubular sizes and the diameter of the wellbore from the casing shoe to the interface allows the nitrogen volume in the annulus to be calculated. The following  $P$ - $V$ - $T$  gas equation is used to calculate the volume of nitrogen at standard temperature and pressure conditions in the wellbore during the test:

$$V_{N_2} = N_{scf} \times \sum_i^N \left[ \frac{(P_{WB})_i \times 144 \times (V_{WB})_i}{(Z_{AVE})_i \times R \times (T_{AVE})_i} \right]$$

where:

$V_{N_2}$  = volume of nitrogen measured in the wellbore over a specific depth interval “ $i$ ” (SCF)

$(P_{WB})_i$  = average calculated wellbore pressure over a specific depth interval “ $i$ ” (psia)

$(V_{WB})_i$  = volume of wellbore of a specific depth interval “ $i$ ” (ft<sup>3</sup>)

$(Z_{AVE})_i$  = gas compressibility factor at a specific depth interval<sup>1</sup> “ $i$ ” (dimensionless)

---

<sup>1</sup> Compressibility Factor ( $Z$ ) research developed in NOWSCO Technical Manual, NOWSCO Services, 1980.





CW-5 MIT Rev. 0

$R$  = specific gas constant  $\left[ 55.16 \left( \frac{(\text{ft} \times \text{lb}_f)}{(\text{lb mol} \times ^\circ\text{R})} \right) \right]$

$(T_{AVE})_i$  = average wellbore temperature for a specific depth interval “ $i$ ” ( $^\circ\text{R}$ )

$N_{scf}$  = gas conversion for mass to volume at standard pressure and temperature conditions  
(13.8 scf<sub>N2</sub> = 1 lb<sub>N2</sub>)

$i = 1, 2, \dots, N$ ,  $N$  = total number of depth intervals.

The following recursive relationship is used to determine pressure at depth interval “ $i$ ”:

$$P_i = P_{i-1} \left[ 1 + \frac{L}{R(Z_{AVE})_i (T_{AVE})_i} \right]$$

$$i = 1, 2, \dots, N$$

where:

$P_i$  = calculated pressure at a specific depth “ $i$ ” (psia)

$P_1$  = measure wellhead pressure (psia)

$L$  = distance between measurement  $i$  and measurement  $i-1$  (ft).

The volume calculation is performed for specific intervals (nominal ten feet) throughout the wellbore from the surface to the interface. The total annulus nitrogen volume is determined by summing the specific volume for each interval.

The results of the volume and mass calculations for the MIT are presented in Appendix C. Note that the surface measured volume of nitrogen may not equal the calculated volume of nitrogen in the wellbore. The accuracy of the metered nitrogen is based on the accuracy of the turbine and temperature measurement made during nitrogen injection. The calculated nitrogen volumes are based on downhole temperature logs, surface pressure recorders, calculated downhole pressures, nitrogen compressibility, known casing size and borehole dimensions determined by sonar survey or nitrogen strapping calculations. All measurements are subject to the accuracy of the instrumentation used at the time of the measurements.

## Calculated Leak Rate

The calculated leak rate (CLR) is the slope of the nitrogen volume versus time data. A negative CLR indicates a calculated loss of nitrogen from the wellbore during the test period. A positive CLR indicates a calculated increase in nitrogen volume during the test period.

CW-5 MIT Rev. 0

## Minimum Detectable Leak Rate

The Minimum Detectable Leak Rate (MDLR) depends on the accuracy of the nitrogen volume calculations and the duration of the test. The accuracy of the nitrogen volume calculations depends *primarily* on the accuracy of the nitrogen pressure measurement, the wellbore temperature measurements, the interface depth measurement and the measurement of the size of the salt shaft below the casing

The calculated apparent leak rate in this test relies on the measurement of pressure and temperature differences using the same measuring device at the start and end of the testing. Both pressure transducers and the downhole temperature and interface tools were changed during the course of the test. Thus the accuracy in the calculated leak rate is dependent on the both level of random precision error in the temperature and pressure measurements as well as equipment biases for the temperature and pressure equipment.

Assuming normally distributed random precision error in both temperature and wellhead pressure, the accuracy of the calculated apparent leak rate can be calculated as the difference in the maximum and minimum gas volumes (at a single point in time such as the end of the MIT) where the maximum and minimum gas volumes are calculated with the temperature and wellhead pressure perturbed by  $\pm 3$  standard deviations of the random or precision error, divided by the duration of the test. The MDLR is estimated as:

$$\text{MDLR} = 3 \times \left[ \frac{V_{N_2}(P + \sigma_P, T - \sigma_T, D + \Delta D) - V_{N_2}(P - \sigma_P, T + \sigma_T, D - \Delta D)}{\Delta t} \right]$$

where:

$V_{N_2}$  = volume of nitrogen measured in the wellbore

$\sigma_P$  = standard deviation in pressure measurement bias

$\sigma_T$  = standard deviation in temperature measurement bias

$\Delta D$  = accuracy of interface measurement

$\Delta t$  = test duration.

This expression for MDLR is associated with a confidence interval >90 percent. The methods for estimating the standard deviation in the temperature and pressure measurement bias are described below.

## Standard Deviation in Well Pressure Measurement Bias

The well pressure in this test should be a smooth function; the measuring device random precision error is exhibited as the scatter of the measured pressures about a smooth function in time. For the pressure calculations, the pressures at the interface measured with the beginning and ending temperature logs were used. A smooth function that is a Fourier series with Fourier



CW-5 MIT Rev. 0

coefficients determined from a minimization of the sum-of-squared-error between the smooth function and the measured pressures can be fitted to the data. The Fourier series used to develop the smooth pressure (versus time) function for the well pressure is:

$$P_{wh}(t) = \bar{P} + \sum_{n=1}^{30} a_n \sin(nt) + b_n \cos(nt)$$

where  $\bar{P}$ ,  $a_n$  and  $b_n$  are fitting parameters. The standard deviation in the “lack of fit” to the smooth function is about 1.108 psi. If the device random precision error is normally distributed, then the true pressures (to a confidence level of greater than about 90 percent) are within about  $\pm 3$  standard deviations of the pressures. Calibration papers for the pressure transducers are included in Appendix D.

## Standard Deviation in Temperature Measurement Bias

Similarly, the temperature as a function of depth should be a smooth function, so the random error in the temperature measurement device can be calculated in a similar manner. Figure 2 illustrates the measured temperature in the well and cavern for the temperature logs run for the MIT. The temperature data is included in Appendix C. The average standard deviation in the lack of fit for the two temperature logs is 0.273° F.

## Interface Depth Measurement Accuracy

The resolution of the interface detection tool is determined from the logging tool used for the MIT. The resolution for the tool is believed to be  $\pm 0.5$  feet.

## Results and Discussion

The tests showed that the calculated leak rate (CLR) from CW-5 was a loss of 32 barrels per year at an average casing shoe pressure of 2,574 psi. The 2,574 psi pressure at the casing shoe is approximately 74% of the overlying lithostatic pressure. This measurement of the CLR uses a linear fit to the nitrogen volume data at the start and at the end of the test. The minimum detectable leak rate (MDLR) was 103 barrels per year. The nitrogen-brine interface remained below the casing shoe and moved uphole slightly (1.5 feet) during the test.

At the time of this test and within the limitations of this test, Storage Well CW-5 demonstrated mechanical integrity as the CLR was less than the MDLR of the test.

Appendix E contains the Mechanical Integrity Test data on the required State forms. A combined log at the start and end of the test is included in Appendix F.



## **Appendix A Mechanical Integrity Test Procedures**

### **NGL Supply Terminal Solution Mining, LLC Mechanical Integrity Test Procedures for Well CW-5**

**April 6, 2016**

Revision 0



## Nitrogen / Brine Interface Mechanical Integrity Test (MIT) Plan

Guideline #:

UIC-3-15

(February 2014)

### Introduction

Operators of all Class III injection wells are required to demonstrate periodically both internal and external mechanical integrity (MI) of the wells. The nitrogen / brine interface test is the industry standard for making this demonstration for solution mined caverns and associated wells for underground hydrocarbon storage. This nitrogen / brine interface test plan template is taken, with permission, from the Kansas Underground Hydrocarbon Storage Unit.

### Plan

The nitrogen/brine interface test is designed to evaluate the internal (well) mechanical integrity and/or the external (cavern) mechanical integrity. Submit a test plan to the Utah Division of Water Quality (DWQ) for review and approval at least 30 days prior to test commencement. Use the following format.

Submit a casing schematic. Attachment #:	Depth to salt: 3184 feet
Single casing <input type="checkbox"/>	Depth to casing shoe: 3480 feet (perforations)
Double casing <input checked="" type="checkbox"/>	Depth to cavern: 3550 feet
	Total depth: 4440 feet
Describe roof configuration: Flat	Date of last sonar survey: April 1, 2016
Salt roof thickness: approximately 363 feet	Date of last gamma-density log: February 27, 2015
Additional logs or test to be run:	1. Gamma Density
	2.
	3.
Maximum operating pressure (MAOP) and test pressures: Maximum Operating Pressure (surface) 800 psi,	Formulas and calculations: $MAOP = \text{Depth} \times \text{Allowable Gradient} - \text{Depth} \times 0.52$ $MAOP = 3480 \times 0.75 - 3480 \times 0.52$ $MAOP = 2610 \text{ psi} - 1810 \text{ psi} = 800 \text{ psi}$



Proposed changes to field procedure described in form UIC-3-16:

Detailed procedures are attached.

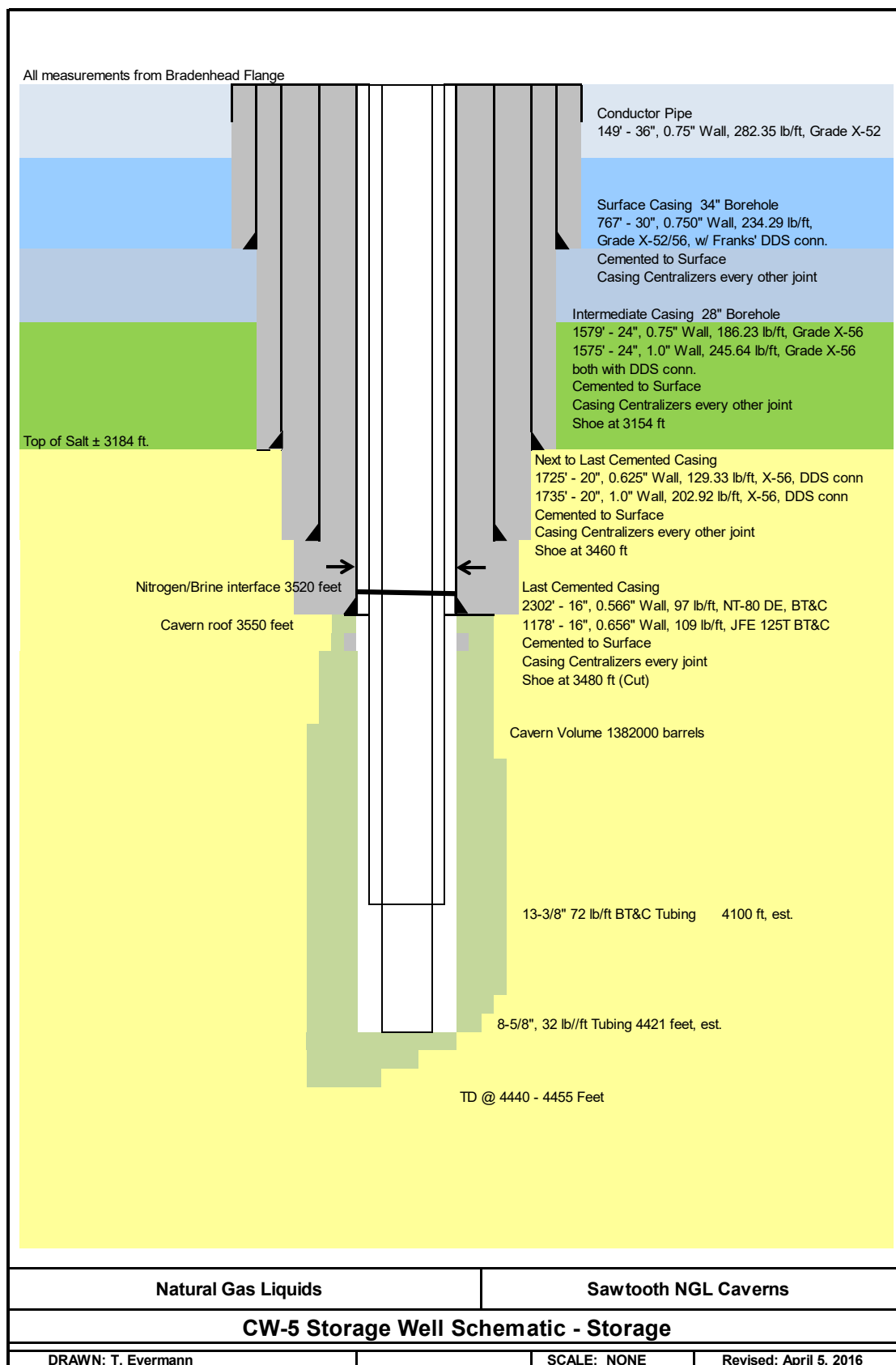
<b>TEST DESIGN:</b> Estimate nitrogen for cool down: N/A - meter will be on wellhead, after nitrogen blow down location.  Estimate compressibility: 3.9 bbls/psi - about 3,000 bbls of brine required  Estimate nitrogen volume for test: 124,000 scf	MIT Type: Casing Cavern <b>Casing and Cavern</b>	
	Interval Depth:	Test Duration:
	1. Cavern (brine hydrostatic)	48 hours
	2. 3520 to surface (nitrogen interface)	24 Hours, estimated
	3	
	4.	
Additional Comments:		

Submit final test report in the format specified in form UIC-3-17 to DWQ within 60 days after completion of the test.

### References

Kansas Department of Health and Environment, Bureau of Water, Geology Section, Underground Hydrocarbon Storage Unit <http://www.kdheks.gov/uhs/>

Bérest P, Brouard B, Durup G. 2001. Tightness tests in salt-cavern wells. Oil & Gas Science and Technology. 56:451-469.







# MECHANICAL INTEGRITY TEST PROCEDURE

## Sawtooth NGL Well CW-5

### 1. INTRODUCTION

- 1.1. The purpose of the Mechanical Integrity Test (MIT) procedure is to test the mechanical integrity of the production casing and cement and to ensure that the wellbore below the casing shoe has integrity before beginning mining. In summary, the test procedure consists of the following basic steps.
- 1.2. Pressuring the well with brine to given test pressure of 800 psi.
- 1.3. Monitoring and recording the cavern pressure for a period of time, minimum 48 hours, until the pressure is decreasing less than 10 psi per day.
- 1.4. Inject nitrogen to place the interface at about 3520 feet depth.
- 1.5. Measuring the position of the nitrogen/brine interface and temperature of the nitrogen column at the beginning and end of the test period,
- 1.6. Recording the brine and nitrogen wellhead pressures throughout the test period, a minimum of 24 hours,
- 1.7. Determining the calculated leak rate and the minimum detectable leak rate.

### 2. PREPARATION

- 2.1. Provide blind flanges and/or double valves to isolate the well during the test. Test flanges with connections may be required for brine wellhead valves.
- 2.2. Install pressure-monitoring equipment on both tubing strings and the cemented annulus connections to allow continuous monitoring of wellhead pressures.
  - 2.2.1. NOTE: Digital pressure recorders and temperature recorders (including logging tools) utilized for the mechanical integrity test shall be calibrated in accordance with manufacturer specifications.
  - 2.2.2. Calibration papers are to be on location, available for DWQ review.
- 2.3. Provide a connection to permit injecting brine into or withdrawing brine from the well.

### 3. BRINE INJECTION AND MONITORING

- 3.1. Pressurize the cavern by injecting saturated (or as strong as possible) brine into the hanging string of the subject well. See the MIT Well Data Sheet for the approximate brine wellhead pressure and estimated volume of brine required. *Use of unsaturated brine may result in: 1) increase in time required to stabilize cavern pressures as the unsaturated brine dissolves salt and 2) the need to repressure the cavern multiple times.*
- 3.2. Measure and record, at approximately fifteen-minute intervals, the volume of fluid injected and the wellhead brine pressure. The rate of pressurization should not exceed 1.5 psi per minute.
- 3.3. Monitor the final brine wellhead pressures for a minimum of 48 hours or longer until the pressures stabilize at an acceptable level and rate of change. Pressure decline rates should be less than 10 psi/day before starting the test.
- 3.4. If the pressure falls below 700 psi during the period of monitoring, inject additional brine and monitor as in steps 3.1 through 3.3.

## 4. NITROGEN INJECTION

- 4.1. Rig up wireline logging unit and install a lubricator on wellhead. Run base interface log (Density or other suitable log for detecting nitrogen/brine interface) and temperature log. Temperature log should be completed from surface to approximately the end of the 13-3/8" tubing. The base interface log should be completed from the end of the 13-3/8" tubing to 300 feet above the cemented casing shoe.
- 4.2. Rig up nitrogen pumping unit to inject into the product annulus. Start injecting nitrogen at a slow rate. Control the nitrogen injection temperature as close as possible to the average wellbore temperature measured by the base temperature log.
- 4.3. Monitor and record nitrogen and brine pressures and flow conditions during injection. The MIT Well Data Sheet lists the appropriate wellhead test pressures. Monitor the differential nitrogen-brine pressure to insure the brine string is not subjected to collapse pressure condition.
- 4.4. While injecting nitrogen, it will be necessary to bleed off brine to avoid overpressuring the well. After the interface reaches 2500 feet (estimated by nitrogen volume), regulate the brine flow to maintain the brine pressure specified in Step 2.0 of the Well Data Sheet.
- 4.5. Find the nitrogen/brine interface with the density tool and track the interface movement down the well by moving the tool down in 100 feet to 150 feet increments after the nitrogen is at 3000 feet. Continue tracking the interface until it reaches the desired depth. Record the nitrogen quantity injected for each interval.
- 4.6. When the interface is at about 3200 feet, stop nitrogen injection to run a casing test.
  - 4.6.1. An initial log is recorded of the interface in the cemented casing. Nitrogen and brine pressures are recorded. The wellhead and associated piping and connections are checked for leaks and any leaks are repaired.
  - 4.6.2. After a time interval determined by the test conditions, but not less than sixty minutes, a second interface log is recorded of the interface in the cemented casing. Nitrogen and brine pressure are recorded.
  - 4.6.3. If the nitrogen pressure has remained constant and the interface in the cemented casing has not moved, the cemented casing string is considered tight and nitrogen injection resumed.
  - 4.6.4. If the interface in the cemented casing moves up hole and the nitrogen pressure decreases the well head is again checked for leaks and the casing test is extended. This procedure is repeated until the casing is considered tight or a leak is identified.
- 4.7. Resume nitrogen injection and record the nitrogen volume, pressure and interface depth at each station. Continue tracking the interface until it reaches approximately the planned interface depth about 40 feet below the 16" casing.
- 4.8. Run a log to verify the position of the nitrogen/brine interface relative to the 16" casing shoe. Determine total volume of nitrogen injected from original interface location to interface location for the MIT. See MIT Well Data Sheet for planned interface depth and estimated volumes.
- 4.9. Remove the logging tool from the well and close the logging valve.
- 4.10. Shut-in well for nitrogen temperature stabilization of at least 18 hours. During the temperature stabilization period, record nitrogen and brine wellhead pressures. Check all



wellhead fittings and flanges with liquid soap or equivalent to insure there are no nitrogen leaks.

- 4.11. Determine the duration of the test using the appropriate test data and following calculation:

$$T = \frac{V \times R \times 365 \text{ days/year} \times 24 \text{ hours/day}}{100 \text{ bbls/year}}$$

Where:

T = Duration of test, 2 hours by formula, with a minimum of 24 hours

V = Unit annular volume of casing, bbls/ft - 0.404 bbls per linear foot estimated based on casing dimension.

R = Resolution of the interface tool, ft, 0.5 feet

There is an over-riding minimum test period of 24 hours.

## 5. TEST INITIALIZATION

- 5.1. After a minimum wait of 18 hours rig up wireline logging unit and install lubricator on wellhead. Run initial density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below interface depth. The density log should be completed from 100 feet below to 200 feet above the interface location below the 16" casing.
- 5.2. Record nitrogen and brine wellhead pressures at least every five minutes during the test.

## 6. TEST FINALIZATION

- 6.1. After the planned test duration, a minimum of 24 hours, run the final density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below to 200 feet above the proposed interface location below the 16" casing.
- 6.2. Record nitrogen and brine wellhead pressures.
- 6.3. If results indicate the test period must be extended, repeat steps 6.1 and 6.2 as required.
- 6.4. If results indicate the MIT is successful, end test
- 6.5. If the test indicates the well is leaking, shut-in the well and continue to monitor nitrogen pressures and interface levels to more closely isolate leak location.

## 7. REPORT ON TEST RESULTS

- 7.1. Prepare a written report presenting test procedures, results and conclusions, along with a chronology of test activity, wellhead pressure records, and supporting calculations.
- 7.2. The Minimum Detectable Leak Rate (MDLR) will be calculated with the following formula:

$$\text{MDLR} = 3 \times \left[ \frac{V_{N_2}(P + \sigma_p, T - \sigma_T, D + \Delta D) - V_{N_2}(P - \sigma_p, T + \sigma_T, D - \Delta D)}{\Delta t} \right]$$

where:

$\sigma_p$  = standard deviation in pressure measurement bias

$\sigma_T$  = standard deviation in temperature measurement bias

$\Delta D$  = accuracy of interface measurement

$\Delta t$  = test duration.

7.3. The Calculated Nitrogen Leak Rate will be determined using the following methodology. In addition to measured quantities, knowledge of the well casing and tubular sizes and previous knowledge of the diameter of the wellbore from the casing shoe to the interface allows the nitrogen volume in the annulus to be calculated. The following  $P$ - $V$ - $T$  gas equation (which is an approximation to an integral over the axis of the annulus) is used to calculate the volume of nitrogen (at standard temperature and pressure conditions) in the wellbore at any time during the test:

$$V_{N_2} = N_{scf} \times \sum_i^N \left[ \frac{(P_{WB})_i \times 144 \times (V_{WB})_i}{(Z_{AVE})_i \times R \times (T_{AVE})_i} \right]$$

where:

$V_{N_2}$  = volume of nitrogen measured in the wellbore over a specific depth interval “ $i$ ” (scf)

$(P_{WB})_i$  = average calculated wellbore pressure over a specific depth interval “ $i$ ” (psia)

$(V_{WB})_i$  = volume of wellbore of a specific depth interval “ $i$ ” (ft<sup>3</sup>)<sup>2</sup>

$(Z_{AVE})_i$  = gas compressibility factor at a specific depth interval “ $i$ ” (dimensionless)

$R$  = specific gas constant  $\left[ 55.16 \left( \frac{\text{ft} \times \text{lb}_f}{\text{lb mol} \times ^\circ\text{R}} \right) \right]$

$(T_{AVE})_i$  = average wellbore temperature over a specific depth interval “ $i$ ” (°R)

$N_{scf}$  = gas conversion for mass to volume at standard pressure and temperature conditions (13.8 scf<sub>N2</sub> = 1 lb<sub>N2</sub>)

$i = 1, 2, \dots, N$ ,  $N$  = total number of depth intervals.

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<sup>2</sup> NOTE: Determined by wellbore geometry.



## **M.I.T. TEST WELL DATA SHEET**

### **1.0 WELL DESCRIPTION**

- 1.1 Name Sawtooth NGL CW-5
- 1.2 Operator Sawtooth Supply Terminal Solution Mining
- 1.3 Location Field Delta
- 1.4 Cemented Casing Size O.D. 16 inches
  - 1.4.1. Size I.D. 14.868 inches
  - 1.4.2. Depth 2302 feet, measured depth
  - 1.4.3. Weight 97 lbs/ft
  - 1.4.4. Size I.D. 14.688 inches
  - 1.4.5. Depth 3480 feet, measured depth to casing cut
  - 1.4.6. Weight 109 lbs/ft
- 1.5 Hanging String – Size 8-5/8 inches
  - 1.5.1 Depth estimated 4420 feet
- 1.6 Hanging String – Size 13-3/8 inches
  - 1.6.1. Depth 4150 feet
- 1.7 Total Depth 4440 feet

### **2.0 TEST PRESSURES**

- 2.1 Brine Specific Gravity in 8-5/8" (Estimated) 1.2
- 2.2 Desired Interface level at start 3520 feet
- 2.3 Test Gradient 0.75 psi/ft
  - 2.3.1 Casing Shoe Pressure 2610 psig
  - 2.3.2 Surface Brine Pressure 800 psig

### **3.0 ANNULUS VOLUME ESTIMATE**

- 3.1 Total Volume to Casing Shoe 136 bbls ( $2302 \text{ feet} \times 0.0404 \text{ bbls/ft} + 1218 \text{ feet} \times 0.0358 \text{ bbls/ft}$ )
- 3.2 Volume from Casing Shoe to Interface Depth 2.0 bbls ( $40 \text{ feet} \times 0.0358 \text{ bbls/ft}$ )

### **4.0 NITROGEN VOLUME**

- 4.1. Nitrogen Volume to Casing Shoe 121,000 SCF
- 4.2. Nitrogen Volume below Casing Shoe 1,000 SCF
- 4.3. Total Nitrogen Volume Required 122,000 SCF

### **5.0 CAVERN COMPRESSIBILITY RESPONSE**

- 5.1 Well Volume 1,380,000 bbls
- 5.2 Well Compressibility, estimated 3.9 bbls/psi
- 5.3 Wellhead Pressure with Brine (before test) 765 psi
- 5.4 Pressure increase due to nitrogen injection, 35 psi
- 5.5 Brine requirement 3,000 barrels ( $765 \text{ psi} \times 3.9 \text{ bbls/psi}$ )



## Appendix B Wellhead Pressures during Well CW-5 MIT

Date	Time	Brine	Nitrogen
4/11/2016	17:41:34	813	938
4/11/2016	18:16:50	812	938
4/11/2016	18:52:06	812	938
4/11/2016	19:27:22	811	938
4/11/2016	20:02:38	810	938
4/11/2016	20:37:54	809	938
4/11/2016	21:13:10	810	938
4/11/2016	21:48:26	809	937
4/11/2016	22:23:42	809	937
4/11/2016	22:58:58	808	938
4/11/2016	23:34:14	807	938
4/11/2016	0:09:30	808	938
4/11/2016	0:44:45	807	938
4/12/2016	1:20:01	807	938
4/12/2016	1:55:17	806	939
4/12/2016	2:30:33	806	939
4/12/2016	3:05:49	806	939
4/12/2016	3:41:05	805	939
4/12/2016	4:16:21	805	939
4/12/2016	4:51:37	805	939
4/12/2016	5:26:53	809	939
4/12/2016	6:02:09	810	939
4/12/2016	6:37:25	810	939
4/12/2016	7:12:41	810	940
4/12/2016	7:47:57	807	940
4/12/2016	8:23:12	806	940
4/12/2016	8:58:28	804	940
4/12/2016	9:33:44	804	941
4/12/2016	10:09:00	804	941
4/12/2016	10:44:16	802	941
4/12/2016	11:19:32	802	941
4/12/2016	11:54:48	802	942
4/12/2016	12:30:04	802	942
4/12/2016	13:05:20	803	942
4/12/2016	13:40:36	802	942
4/12/2016	14:15:52	802	943
4/12/2016	14:51:08	802	943
4/12/2016	15:26:23	804	943





4/12/2016	16:01:39	802	943
4/12/2016	16:36:55	802	943
4/12/2016	17:12:11	802	943
4/12/2016	17:47:27	801	943
4/12/2016	18:22:43	802	943
4/12/2016	18:57:59	802	943
4/12/2016	19:33:15	802	943
4/12/2016	20:08:31	800	943
4/12/2016	20:43:47	799	943
4/12/2016	21:19:03	800	943
4/12/2016	21:54:19	801	943
4/12/2016	22:29:34	801	943
4/12/2016	23:04:50	800	943
4/12/2016	23:40:06	800	943
4/12/2016	0:15:22	800	943
4/12/2016	0:50:38	799	943
4/13/2016	1:25:54	799	943
4/13/2016	2:01:10	799	943
4/13/2016	2:36:26	799	943
4/13/2016	3:11:42	797	943
4/13/2016	3:46:58	797	944
4/13/2016	4:22:14	797	944
4/13/2016	4:57:30	797	944
4/13/2016	5:32:45	797	944
4/13/2016	6:08:01	797	944
4/13/2016	6:43:17	797	944
4/13/2016	7:18:33	797	944
4/13/2016	7:53:49	798	945
4/13/2016	8:29:05	798	945
4/13/2016	9:04:21	796	945
4/13/2016	9:39:37	796	946
4/13/2016	10:14:53	797	946
4/13/2016	10:50:09	796	946
4/13/2016	11:25:25	797	946
4/13/2016	12:00:41	796	947
4/13/2016	12:35:57	796	947
4/13/2016	13:11:12	796	947
4/13/2016	13:46:28	796	947
4/13/2016	14:21:44	796	948
4/13/2016	14:57:00	797	948
4/13/2016	15:32:16	796	948



4/13/2016	16:07:32	795	948
4/13/2016	16:42:48	795	948
4/13/2016	17:18:04	795	948
4/13/2016	17:53:20	797	948
4/13/2016	18:28:36	797	948
4/13/2016	19:03:52	797	948
4/13/2016	19:39:08	796	948
4/13/2016	20:14:23	796	948
4/13/2016	20:49:39	796	948
4/13/2016	21:24:55	795	948
4/13/2016	22:00:11	797	948
4/13/2016	22:35:27	798	948
4/13/2016	23:10:43	798	948
4/13/2016	23:45:59	798	948
4/13/2016	0:21:15	798	949
4/13/2016	0:56:31	798	949
4/14/2016	1:31:47	798	949
4/14/2016	2:07:03	797	949
4/14/2016	2:42:19	797	949
4/14/2016	3:17:34	797	950
4/14/2016	3:52:50	797	950
4/14/2016	4:28:06	797	950
4/14/2016	5:03:22	797	951
4/14/2016	5:38:38	797	951
4/14/2016	6:13:54	797	951
4/14/2016	6:49:10	797	951
4/14/2016	7:24:26	797	951
4/14/2016	7:59:42	795	952
4/14/2016	8:34:58	793	952
4/14/2016	9:10:14	792	953
4/14/2016	9:45:30	792	954
4/14/2016	10:20:45	792	954
4/14/2016	10:56:01	793	954
4/14/2016	11:31:17	792	954
4/14/2016	12:06:33	792	955
4/14/2016	12:41:49	793	955
4/14/2016	13:17:05	792	955
4/14/2016	13:52:21	795	955
4/14/2016	14:27:37	795	955
4/14/2016	15:02:53	795	955
4/14/2016	15:38:09	794	956



4/14/2016	16:13:25	794	956
4/14/2016	16:48:41	793	957
4/14/2016	17:23:57	793	957
4/14/2016	17:59:12	794	957
4/14/2016	18:34:28	793	957
4/14/2016	19:09:44	794	957
4/14/2016	19:45:00	794	957
4/14/2016	20:20:16	793	957
4/14/2016	20:55:32	796	957
4/14/2016	21:30:48	798	957
4/14/2016	22:06:04	798	957
4/14/2016	22:41:20	798	957
4/14/2016	23:16:36	797	957
4/14/2016	23:51:52	797	957
4/14/2016	0:27:08	797	958
4/15/2016	1:02:23	797	958
4/15/2016	1:37:39	797	958
4/15/2016	2:12:55	797	958
4/15/2016	2:48:11	797	958
4/15/2016	3:23:27	797	959
4/15/2016	3:58:43	797	959
4/15/2016	4:33:59	797	959
4/15/2016	5:09:15	797	959
4/15/2016	5:44:31	797	960
4/15/2016	6:19:47	797	960
4/15/2016	6:55:03	797	960
4/15/2016	7:30:19	797	960
4/15/2016	8:05:34	797	960
4/15/2016	8:40:50	797	961
4/15/2016	9:16:06	794	961
4/15/2016	9:51:22	794	962
4/15/2016	10:26:38	792	962
4/15/2016	11:01:54	793	962
4/15/2016	11:37:10	793	962
4/15/2016	12:12:26	792	963
4/15/2016	12:47:42	792	963
4/15/2016	13:22:58	792	963
4/15/2016	13:58:14	792	963
4/15/2016	14:33:30	793	964
4/15/2016	15:08:45	793	965
4/15/2016	15:44:01	792	965



4/15/2016	16:19:17	792	965
4/15/2016	16:54:33	796	965
4/15/2016	17:29:49	796	965
4/15/2016	18:05:05	792	966
4/15/2016	18:40:21	792	966
4/15/2016	19:15:37	792	966
4/15/2016	19:50:53	791	966
4/15/2016	20:26:09	790	966
4/15/2016	21:01:25	794	966
4/15/2016	21:36:41	796	966
4/15/2016	22:11:57	797	967
4/15/2016	22:47:12	796	967
4/15/2016	23:22:28	796	967
4/15/2016	23:57:44	796	967
4/15/2016	0:33:00	796	967
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4/16/2016	1:43:32	796	968
4/16/2016	2:18:48	796	968
4/16/2016	2:54:04	794	968
4/16/2016	3:29:20	795	968
4/16/2016	4:04:36	794	968
4/16/2016	4:39:52	794	969
4/16/2016	5:15:08	794	969
4/16/2016	5:50:23	794	969
4/16/2016	6:25:39	794	969
4/16/2016	7:00:55	796	969
4/16/2016	7:36:11	795	970
4/16/2016	8:11:27	794	970
4/16/2016	8:46:43	790	970
4/16/2016	9:21:59	791	971
4/16/2016	9:57:15	790	971
4/16/2016	10:32:31	791	972
4/16/2016	11:07:47	791	972
4/16/2016	11:43:03	791	972
4/16/2016	12:18:19	791	973
4/16/2016	12:53:34	793	973
4/16/2016	13:28:50	791	973
4/16/2016	14:04:06	791	974
4/16/2016	14:39:22	791	974
4/16/2016	15:14:38	792	974
4/16/2016	15:49:54	793	975



4/16/2016	16:25:10	790	975
4/16/2016	17:00:26	790	975
4/16/2016	17:35:42	790	975
4/16/2016	18:10:58	790	975
4/16/2016	18:46:14	792	975
4/16/2016	19:21:30	792	975
4/16/2016	19:56:45	791	975
4/16/2016	20:32:01	789	976
4/16/2016	21:07:17	789	976
4/16/2016	21:42:33	789	976
4/16/2016	22:17:49	791	976
4/16/2016	22:53:05	796	976
4/16/2016	23:28:21	796	976
4/16/2016	0:03:37	795	977
4/16/2016	0:38:53	795	977
4/17/2016	1:14:09	795	977
4/17/2016	1:49:25	795	977
4/17/2016	2:24:41	796	978
4/17/2016	2:59:57	796	978
4/17/2016	3:35:12	796	978
4/17/2016	4:10:28	796	978
4/17/2016	4:45:44	796	979
4/17/2016	5:21:00	795	979
4/17/2016	5:56:16	795	979
4/17/2016	6:31:32	793	979
4/17/2016	7:06:48	794	979
4/17/2016	7:42:04	793	980
4/17/2016	8:17:20	791	980
4/17/2016	8:52:36	790	981
4/17/2016	9:27:52	791	981
4/17/2016	10:03:08	792	982
4/17/2016	10:38:23	791	982
4/17/2016	11:13:39	789	982
4/17/2016	11:48:55	791	983
4/17/2016	12:24:11	791	983
4/17/2016	12:59:27	792	983
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4/17/2016	14:09:59	792	984
4/17/2016	14:45:15	790	985
4/17/2016	15:20:31	790	985
4/17/2016	15:55:47	790	985



4/17/2016	16:31:03	790	986
4/17/2016	17:06:19	790	986
4/17/2016	17:41:34	790	986
4/17/2016	18:16:50	790	986
4/17/2016	18:52:06	789	986
4/17/2016	19:27:22	790	986
4/17/2016	20:02:38	792	987
4/17/2016	20:37:54	790	987
4/17/2016	21:13:10	789	987
4/17/2016	21:48:26	789	987
4/17/2016	22:23:42	791	987
4/17/2016	22:58:58	796	987
4/17/2016	23:34:14	795	988
4/17/2016	0:09:30	795	988
4/17/2016	0:44:45	795	988
4/18/2016	1:20:01	795	988
4/18/2016	1:55:17	795	989
4/18/2016	2:30:33	795	989
4/18/2016	3:05:49	795	989
4/18/2016	3:41:05	795	990
4/18/2016	4:16:21	795	990
4/18/2016	4:51:37	795	990
4/18/2016	5:26:53	795	990
4/18/2016	6:02:09	796	990
4/18/2016	6:37:25	795	990
4/18/2016	7:12:41	796	991
4/18/2016	7:47:57	794	991
4/18/2016	8:23:12	793	992
4/18/2016	8:58:28	791	992
4/18/2016	9:33:44	790	993
4/18/2016	10:09:00	792	993
4/18/2016	10:44:16	792	993
4/18/2016	11:19:32	791	994
4/18/2016	11:54:48	792	994
4/18/2016	12:30:04	792	994
4/18/2016	13:05:20	792	995
4/18/2016	13:40:36	791	995
4/18/2016	14:15:52	793	996
4/18/2016	14:51:08	791	996
4/18/2016	15:26:23	790	996
4/18/2016	16:01:39	790	997



4/18/2016	16:36:55	790	997
4/18/2016	17:12:11	791	998
4/18/2016	17:47:27	791	998
4/18/2016	18:22:43	790	998
4/18/2016	18:57:59	790	998
4/18/2016	19:33:15	789	998
4/18/2016	20:08:31	792	998
4/18/2016	20:43:47	791	998
4/18/2016	21:19:03	796	998
4/18/2016	21:54:19	796	998
4/18/2016	22:29:34	795	998
4/18/2016	23:04:50	795	998
4/18/2016	23:40:06	795	998
4/18/2016	0:15:22	796	998
4/18/2016	0:50:38	795	999
4/19/2016	1:25:54	795	999
4/19/2016	2:01:10	795	999
4/19/2016	2:36:26	795	999
4/19/2016	3:11:42	794	1000
4/19/2016	3:46:58	794	1000
4/19/2016	4:22:14	794	1000
4/19/2016	4:57:30	794	1001
4/19/2016	5:32:45	796	1001
4/19/2016	6:08:01	796	1001
4/19/2016	6:43:17	796	1001
4/19/2016	7:18:33	795	1002
4/19/2016	7:53:49	794	1002
4/19/2016	8:29:05	792	1003
4/19/2016	9:04:21	791	1003
4/19/2016	9:39:37	791	1004
4/19/2016	10:14:53	791	1004
4/19/2016	10:50:09	792	1004
4/19/2016	11:25:25	792	1005
4/19/2016	12:00:41	793	1005
4/19/2016	12:35:57	789	1006
4/19/2016	13:11:12	789	1006
4/19/2016	13:46:28	790	1007
4/19/2016	14:21:44	790	1008
4/19/2016	14:57:00	790	1008
4/19/2016	15:32:16	790	1008
4/19/2016	16:07:32	790	1009





4/19/2016	16:42:48	790	1009
4/19/2016	17:18:04	790	1009
4/19/2016	17:53:20	791	1009
4/19/2016	18:28:36	791	1009
4/19/2016	19:03:52	791	1010
4/19/2016	19:39:08	790	1010
4/19/2016	20:14:23	790	1010
4/19/2016	20:49:39	791	1010
4/19/2016	21:24:55	792	1010
4/19/2016	22:00:11	791	1009
4/19/2016	22:35:27	791	1010
4/19/2016	23:10:43	791	1010
4/19/2016	23:45:59	790	1010
4/19/2016	0:21:15	791	1010
4/19/2016	0:56:31	791	1010
4/20/2016	1:31:47	791	1010
4/20/2016	2:07:03	794	1010
4/20/2016	2:42:19	796	1011
4/20/2016	3:17:34	796	1011
4/20/2016	3:52:50	796	1011
4/20/2016	4:28:06	796	1011
4/20/2016	5:03:22	795	1011
4/20/2016	5:38:38	796	1012
4/20/2016	6:13:54	795	1012
4/20/2016	6:49:10	795	1012
4/20/2016	7:24:26	794	1012
4/20/2016	7:59:42	791	1013
4/20/2016	8:34:58	792	1013
4/20/2016	9:10:14	791	1014
4/20/2016	9:45:30	793	1014
4/20/2016	10:20:45	791	1015
4/20/2016	10:56:01	790	1015
4/20/2016	11:31:17	795	1238
4/20/2016	12:06:33	803	1597
4/20/2016	12:41:49	813	2034
4/20/2016	13:17:05	812	2056
4/20/2016	13:52:21	813	2056
4/20/2016	14:27:37	814	2130
4/20/2016	15:02:53	817	2203
4/20/2016	15:38:09	816	2203
4/20/2016	16:13:25	818	2269



4/20/2016	16:48:41	818	2294
4/20/2016	17:23:57	819	2295
4/20/2016	17:59:12	818	2295
4/20/2016	18:34:28	819	2294
4/20/2016	19:09:44	818	2294
4/20/2016	19:45:00	818	2293
4/20/2016	20:20:16	817	2293
4/20/2016	20:55:32	816	2292
4/20/2016	21:30:48	815	2291
4/20/2016	22:06:04	817	2291
4/20/2016	22:41:20	818	2291
4/20/2016	23:16:36	818	2291
4/20/2016	23:51:52	818	2291
4/20/2016	0:27:08	818	2291
4/21/2016	1:02:23	817	2291
4/21/2016	1:37:39	818	2290
4/21/2016	2:12:55	819	2290
4/21/2016	2:48:11	819	2290
4/21/2016	3:23:27	819	2290
4/21/2016	3:58:43	818	2290
4/21/2016	4:33:59	818	2290
4/21/2016	5:09:15	818	2290
4/21/2016	5:44:31	818	2291
4/21/2016	6:19:47	822	2290
4/21/2016	6:55:03	822	2290
4/21/2016	7:30:19	820	2291
4/21/2016	8:05:34	816	2291
4/21/2016	8:40:50	816	2292
4/21/2016	9:16:06	816	2293
4/21/2016	9:51:22	815	2293
4/21/2016	10:26:38	817	2294
4/21/2016	11:01:54	816	2294
4/21/2016	11:37:10	816	2294
4/21/2016	12:12:26	816	2294
4/21/2016	12:47:42	816	2295
4/21/2016	13:22:58	817	2295
4/21/2016	13:58:14	818	2296
4/21/2016	14:33:30	818	2296
4/21/2016	15:08:45	817	2296
4/21/2016	15:17:54	817	2296
4/21/2016	15:53:10	817	2296



4/21/2016	16:28:26	817	2296
4/21/2016	17:03:42	818	2296
4/21/2016	17:38:58	818	2296
4/21/2016	18:14:14	818	2297
4/21/2016	18:49:30	818	2296
4/21/2016	19:24:46	817	2296
4/21/2016	20:00:02	816	2295
4/21/2016	20:35:17	816	2294
4/21/2016	21:10:33	815	2294
4/21/2016	21:45:49	815	2294
4/21/2016	22:21:05	818	2293
4/21/2016	22:56:21	818	2293
4/21/2016	23:31:37	818	2293
4/21/2016	0:06:53	818	2293
4/21/2016	0:42:09	817	2293
4/22/2016	1:17:25	817	2293
4/22/2016	1:52:41	817	2293
4/22/2016	2:27:57	817	2293
4/22/2016	3:03:13	817	2293
4/22/2016	3:38:28	817	2293
4/22/2016	4:13:44	816	2292
4/22/2016	4:49:00	816	2292
4/22/2016	5:24:16	816	2292
4/22/2016	5:59:32	816	2292
4/22/2016	6:34:48	816	2292
4/22/2016	7:10:04	816	2292
4/22/2016	7:45:20	816	2292
4/22/2016	8:20:36	817	2293
4/22/2016	8:55:52	816	2293
4/22/2016	9:31:08	815	2293
4/22/2016	10:06:24	815	2294
4/22/2016	10:41:39	816	2295

## Appendix C Temperature and Nitrogen Data during Well CW-5 MIT

Table D-1 Temperature and Nitrogen Data Start Test CW-5

Depth (ft)	Volume (ft3)		Temperature		Pressure		Nitrogen (ft3) STP
	Incremental	Total	(°F)	(°R)	(psig)	psia)	
0	0	0	61.0	521.0	2294.0	2308.7	0.0
10	2.30	2.30	63.0	523.0	2294.8	2309.5	356.1
20	2.30	4.60	63.3	523.3	2295.6	2310.2	355.3
30	2.30	6.90	63.5	523.5	2296.3	2311.0	355.2
40	2.30	9.20	63.5	523.5	2297.1	2311.8	355.2
50	2.30	11.50	63.5	523.5	2297.9	2312.6	355.3
60	2.30	13.80	63.5	523.5	2298.7	2313.4	355.5
70	2.30	16.10	63.5	523.5	2299.5	2314.1	355.6
80	2.30	18.40	63.5	523.5	2300.2	2314.9	355.7
90	2.30	20.70	63.7	523.7	2301.0	2315.7	355.7
100	2.30	23.00	63.6	523.6	2301.8	2316.5	355.8
110	2.30	25.30	63.8	523.8	2302.6	2317.3	355.8
120	2.30	27.60	63.7	523.7	2303.4	2318.0	355.9
130	2.30	29.90	63.9	523.9	2304.1	2318.8	356.0
140	2.30	32.20	64.0	524.0	2304.9	2319.6	356.0
150	2.30	34.50	64.2	524.2	2305.7	2320.4	356.0
160	2.30	36.80	64.2	524.2	2306.5	2321.2	356.0
170	2.30	39.10	64.5	524.5	2307.3	2322.0	356.0
180	2.30	41.40	64.6	524.6	2308.1	2322.7	355.9
190	2.30	43.70	64.6	524.6	2308.8	2323.5	356.0
200	2.30	46.00	64.7	524.7	2309.6	2324.3	356.1
210	2.30	48.30	64.8	524.8	2310.4	2325.1	356.1
220	2.30	50.60	64.9	524.9	2311.2	2325.9	356.2
230	2.30	52.90	64.9	524.9	2312.0	2326.6	356.3
240	2.30	55.20	65.0	525.0	2312.7	2327.4	356.3
250	2.30	57.50	65.1	525.1	2313.5	2328.2	356.3
260	2.30	59.80	65.1	525.1	2314.3	2329.0	356.4
270	2.30	62.10	65.2	525.2	2315.1	2329.8	356.5
280	2.30	64.40	65.3	525.3	2315.9	2330.6	356.5
290	2.30	66.70	65.5	525.5	2316.7	2331.3	356.5
300	2.30	69.00	65.6	525.6	2317.4	2332.1	356.5
310	2.30	71.30	65.6	525.6	2318.2	2332.9	356.5
320	2.30	73.59	65.7	525.7	2319.0	2333.7	356.6
330	2.30	75.89	65.7	525.7	2319.8	2334.5	356.7
340	2.30	78.19	65.8	525.8	2320.6	2335.3	356.8
350	2.30	80.49	65.9	525.9	2321.4	2336.0	356.8
360	2.30	82.79	65.9	525.9	2322.1	2336.8	356.9



370	2.30	85.09	66.1	526.1	2322.9	2337.6	356.9
380	2.30	87.39	66.0	526.0	2323.7	2338.4	357.0
390	2.30	89.69	66.3	526.3	2324.5	2339.2	357.0
400	2.30	91.99	66.5	526.5	2325.3	2340.0	356.9
410	2.30	94.29	66.6	526.6	2326.1	2340.7	356.9
420	2.30	96.59	66.6	526.6	2326.8	2341.5	357.0
430	2.30	98.89	66.7	526.7	2327.6	2342.3	357.1
440	2.30	101.19	66.7	526.7	2328.4	2343.1	357.1
450	2.30	103.49	66.8	526.8	2329.2	2343.9	357.2
460	2.30	105.79	66.9	526.9	2330.0	2344.7	357.3
470	2.30	108.09	66.9	526.9	2330.8	2345.4	357.3
480	2.30	110.39	67.0	527.0	2331.5	2346.2	357.4
490	2.30	112.69	67.2	527.2	2332.3	2347.0	357.4
500	2.30	114.99	67.3	527.3	2333.1	2347.8	357.4
510	2.30	117.29	67.6	527.6	2333.9	2348.6	357.3
520	2.30	119.59	67.5	527.5	2334.7	2349.4	357.4
530	2.30	121.89	67.7	527.7	2335.5	2350.1	357.4
540	2.30	124.19	67.7	527.7	2336.2	2350.9	357.4
550	2.30	126.49	67.8	527.8	2337.0	2351.7	357.5
560	2.30	128.79	67.8	527.8	2337.8	2352.5	357.6
570	2.30	131.09	68.0	528.0	2338.6	2353.3	357.6
580	2.30	133.39	68.1	528.1	2339.4	2354.1	357.6
590	2.30	135.69	68.3	528.3	2340.2	2354.9	357.6
600	2.30	137.99	68.4	528.4	2341.0	2355.6	357.6
610	2.30	140.29	68.3	528.3	2341.7	2356.4	357.7
620	2.30	142.59	68.5	528.5	2342.5	2357.2	357.8
630	2.30	144.89	68.6	528.6	2343.3	2358.0	357.8
640	2.30	147.19	68.7	528.7	2344.1	2358.8	357.8
650	2.30	149.49	68.8	528.8	2344.9	2359.6	357.8
660	2.30	151.79	68.9	528.9	2345.7	2360.4	357.9
670	2.30	154.09	69.1	529.1	2346.5	2361.1	357.9
680	2.30	156.39	69.3	529.3	2347.2	2361.9	357.8
690	2.30	158.69	69.5	529.5	2348.0	2362.7	357.8
700	2.30	160.99	69.5	529.5	2348.8	2363.5	357.8
710	2.30	163.29	69.6	529.6	2349.6	2364.3	357.9
720	2.30	165.59	69.7	529.7	2350.4	2365.1	357.9
730	2.30	167.89	69.8	529.8	2351.2	2365.8	357.9
740	2.30	170.19	69.9	529.9	2352.0	2366.6	358.0
750	2.30	172.49	70.0	530.0	2352.7	2367.4	358.0
760	2.30	174.79	70.2	530.2	2353.5	2368.2	358.0
770	2.30	177.09	70.2	530.2	2354.3	2369.0	358.0
780	2.30	179.39	70.4	530.4	2355.1	2369.8	358.0
790	2.30	181.69	70.6	530.6	2355.9	2370.6	358.0
800	2.30	183.99	70.6	530.6	2356.7	2371.3	358.0
810	2.30	186.29	70.6	530.6	2357.5	2372.1	358.1



820	2.30	188.59	70.7	530.7	2358.2	2372.9	358.2
830	2.30	190.89	70.8	530.8	2359.0	2373.7	358.2
840	2.30	193.19	70.9	530.9	2359.8	2374.5	358.3
850	2.30	195.49	71.1	531.1	2360.6	2375.3	358.3
860	2.30	197.79	71.1	531.1	2361.4	2376.1	358.3
870	2.30	200.09	71.0	531.0	2362.2	2376.9	358.4
880	2.30	202.39	71.3	531.3	2363.0	2377.6	358.4
890	2.30	204.69	71.4	531.4	2363.7	2378.4	358.4
900	2.30	206.99	71.6	531.6	2364.5	2379.2	358.4
910	2.30	209.29	71.7	531.7	2365.3	2380.0	358.4
920	2.30	211.59	71.7	531.7	2366.1	2380.8	358.5
930	2.30	213.89	71.8	531.8	2366.9	2381.6	358.5
940	2.30	216.19	71.9	531.9	2367.7	2382.4	358.6
950	2.30	218.49	72.0	532.0	2368.5	2383.1	358.6
960	2.30	220.78	72.0	532.0	2369.3	2383.9	358.7
970	2.30	223.08	72.2	532.2	2370.0	2384.7	358.7
980	2.30	225.38	72.4	532.4	2370.8	2385.5	358.6
990	2.30	227.68	72.5	532.5	2371.6	2386.3	358.6
1000	2.30	229.98	72.6	532.6	2372.4	2387.1	358.7
1010	2.30	232.28	72.7	532.7	2373.2	2387.9	358.7
1020	2.30	234.58	72.8	532.8	2374.0	2388.7	358.8
1030	2.30	236.88	72.9	532.9	2374.8	2389.4	358.8
1040	2.30	239.18	73.0	533.0	2375.6	2390.2	358.8
1050	2.30	241.48	73.2	533.2	2376.3	2391.0	358.8
1060	2.30	243.78	73.1	533.1	2377.1	2391.8	358.9
1070	2.30	246.08	73.3	533.3	2377.9	2392.6	359.0
1080	2.30	248.38	73.5	533.5	2378.7	2393.4	358.9
1090	2.30	250.68	73.6	533.6	2379.5	2394.2	358.9
1100	2.30	252.98	73.7	533.7	2380.3	2395.0	358.9
1110	2.30	255.28	73.9	533.9	2381.1	2395.7	358.9
1120	2.30	257.58	73.9	533.9	2381.9	2396.5	359.0
1130	2.30	259.88	74.1	534.1	2382.6	2397.3	359.0
1140	2.30	262.18	74.4	534.4	2383.4	2398.1	358.9
1150	2.30	264.48	74.6	534.6	2384.2	2398.9	358.8
1160	2.30	266.78	74.6	534.6	2385.0	2399.7	358.8
1170	2.30	269.08	74.7	534.7	2385.8	2400.5	358.9
1180	2.30	271.38	74.8	534.8	2386.6	2401.3	358.9
1190	2.30	273.68	75.0	535.0	2387.4	2402.1	358.9
1200	2.30	275.98	75.0	535.0	2388.2	2402.8	359.0
1210	2.30	278.28	75.1	535.1	2388.9	2403.6	359.0
1220	2.30	280.58	75.1	535.1	2389.7	2404.4	359.1
1230	2.30	282.88	75.2	535.2	2390.5	2405.2	359.1
1240	2.30	285.18	75.4	535.4	2391.3	2406.0	359.1
1250	2.30	287.48	75.5	535.5	2392.1	2406.8	359.1
1260	2.30	289.78	75.6	535.6	2392.9	2407.6	359.1



1270	2.30	292.08	75.7	535.7	2393.7	2408.4	359.2
1280	2.30	294.38	75.8	535.8	2394.5	2409.1	359.2
1290	2.30	296.68	75.9	535.9	2395.3	2409.9	359.2
1300	2.30	298.98	76.1	536.1	2396.0	2410.7	359.2
1310	2.30	301.28	76.2	536.2	2396.8	2411.5	359.2
1320	2.30	303.58	76.4	536.4	2397.6	2412.3	359.2
1330	2.30	305.88	76.5	536.5	2398.4	2413.1	359.2
1340	2.30	308.18	76.6	536.6	2399.2	2413.9	359.3
1350	2.30	310.48	76.7	536.7	2400.0	2414.7	359.3
1360	2.30	312.78	76.8	536.8	2400.8	2415.5	359.3
1370	2.30	315.08	76.9	536.9	2401.6	2416.2	359.4
1380	2.30	317.38	77.1	537.1	2402.4	2417.0	359.4
1390	2.30	319.68	77.2	537.2	2403.1	2417.8	359.3
1400	2.30	321.98	77.5	537.5	2403.9	2418.6	359.3
1410	2.30	324.28	77.8	537.8	2404.7	2419.4	359.2
1420	2.30	326.58	77.8	537.8	2405.5	2420.2	359.1
1430	2.30	328.88	77.9	537.9	2406.3	2421.0	359.2
1440	2.30	331.18	78.0	538.0	2407.1	2421.8	359.3
1450	2.30	333.48	78.1	538.1	2407.9	2422.6	359.3
1460	2.30	335.78	78.2	538.2	2408.7	2423.3	359.3
1470	2.30	338.08	78.3	538.3	2409.4	2424.1	359.3
1480	2.30	340.38	78.4	538.4	2410.2	2424.9	359.4
1490	2.30	342.68	78.3	538.3	2411.0	2425.7	359.5
1500	2.30	344.98	78.4	538.4	2411.8	2426.5	359.6
1510	2.30	347.28	78.6	538.6	2412.6	2427.3	359.6
1520	2.30	349.58	78.7	538.7	2413.4	2428.1	359.6
1530	2.30	351.88	78.8	538.8	2414.2	2428.9	359.6
1540	2.30	354.18	79.0	539.0	2415.0	2429.7	359.6
1550	2.30	356.48	79.0	539.0	2415.8	2430.4	359.6
1560	2.30	358.78	79.2	539.2	2416.6	2431.2	359.6
1570	2.30	361.08	79.4	539.4	2417.3	2432.0	359.6
1580	2.30	363.38	79.4	539.4	2418.1	2432.8	359.6
1590	2.30	365.67	79.5	539.5	2418.9	2433.6	359.7
1600	2.30	367.97	79.7	539.7	2419.7	2434.4	359.7
1610	2.30	370.27	79.9	539.9	2420.5	2435.2	359.7
1620	2.30	372.57	80.0	540.0	2421.3	2436.0	359.7
1630	2.30	374.87	80.3	540.3	2422.1	2436.8	359.6
1640	2.30	377.17	80.4	540.4	2422.9	2437.5	359.5
1650	2.30	379.47	80.5	540.5	2423.7	2438.3	359.6
1660	2.30	381.77	80.6	540.6	2424.4	2439.1	359.6
1670	2.30	384.07	80.8	540.8	2425.2	2439.9	359.6
1680	2.30	386.37	80.9	540.9	2426.0	2440.7	359.6
1690	2.30	388.67	81.0	541.0	2426.8	2441.5	359.6
1700	2.30	390.97	81.1	541.1	2427.6	2442.3	359.6
1710	2.30	393.27	81.3	541.3	2428.4	2443.1	359.7





1720	2.30	395.57	81.5	541.5	2429.2	2443.9	359.6
1730	2.30	397.87	81.7	541.7	2430.0	2444.7	359.5
1740	2.30	400.17	81.8	541.8	2430.8	2445.4	359.5
1750	2.30	402.47	82.0	542.0	2431.5	2446.2	359.5
1760	2.30	404.77	82.2	542.2	2432.3	2447.0	359.5
1770	2.30	407.07	82.4	542.4	2433.1	2447.8	359.4
1780	2.30	409.37	82.5	542.5	2433.9	2448.6	359.4
1790	2.30	411.67	82.6	542.6	2434.7	2449.4	359.5
1800	2.30	413.97	82.7	542.7	2435.5	2450.2	359.5
1810	2.30	416.27	82.7	542.7	2436.3	2451.0	359.6
1820	2.30	418.57	83.0	543.0	2437.1	2451.8	359.5
1830	2.30	420.87	83.2	543.2	2437.9	2452.5	359.4
1840	2.30	423.17	83.4	543.4	2438.7	2453.3	359.4
1850	2.30	425.47	83.6	543.6	2439.4	2454.1	359.4
1860	2.30	427.77	83.6	543.6	2440.2	2454.9	359.4
1870	2.30	430.07	83.9	543.9	2441.0	2455.7	359.4
1880	2.30	432.37	84.0	544.0	2441.8	2456.5	359.3
1890	2.30	434.67	84.1	544.1	2442.6	2457.3	359.3
1900	2.30	436.97	84.4	544.4	2443.4	2458.1	359.3
1910	2.30	439.27	84.5	544.5	2444.2	2458.9	359.3
1920	2.30	441.57	84.7	544.7	2445.0	2459.6	359.3
1930	2.30	443.87	84.8	544.8	2445.7	2460.4	359.3
1940	2.30	446.17	84.8	544.8	2446.5	2461.2	359.3
1950	2.30	448.47	84.9	544.9	2447.3	2462.0	359.4
1960	2.30	450.77	85.1	545.1	2448.1	2462.8	359.3
1970	2.30	453.07	85.3	545.3	2448.9	2463.6	359.3
1980	2.30	455.37	85.5	545.5	2449.7	2464.4	359.3
1990	2.30	457.67	85.6	545.6	2450.5	2465.2	359.3
2000	2.30	459.97	85.6	545.6	2451.3	2465.9	359.4
2010	2.30	462.27	85.7	545.7	2452.1	2466.7	359.4
2020	2.30	464.57	85.8	545.8	2452.8	2467.5	359.4
2030	2.30	466.87	85.8	545.8	2453.6	2468.3	359.5
2040	2.30	469.17	86.2	546.2	2454.4	2469.1	359.5
2050	2.30	471.47	86.4	546.4	2455.2	2469.9	359.4
2060	2.30	473.77	86.6	546.6	2456.0	2470.7	359.3
2070	2.30	476.07	86.8	546.8	2456.8	2471.5	359.3
2080	2.30	478.37	86.9	546.9	2457.6	2472.3	359.3
2090	2.30	480.67	87.0	547.0	2458.4	2473.0	359.3
2100	2.30	482.97	87.4	547.4	2459.2	2473.8	359.2
2110	2.30	485.27	87.6	547.6	2459.9	2474.6	359.1
2120	2.30	487.57	87.8	547.8	2460.7	2475.4	359.0
2130	2.30	489.87	88.0	548.0	2461.5	2476.2	359.0
2140	2.30	492.17	88.2	548.2	2462.3	2477.0	358.9
2150	2.30	494.47	88.4	548.4	2463.1	2477.8	358.9
2160	2.30	496.77	88.4	548.4	2463.9	2478.6	358.9



2170	2.30	499.07	88.5	548.5	2464.7	2479.4	359.0
2180	2.30	501.37	88.5	548.5	2465.5	2480.1	359.0
2190	2.30	503.67	88.6	548.6	2466.2	2480.9	359.1
2200	2.30	505.97	88.7	548.7	2467.0	2481.7	359.1
2210	2.30	508.27	88.8	548.8	2467.8	2482.5	359.1
2220	2.30	510.56	88.6	548.6	2468.6	2483.3	359.3
2230	2.30	512.86	88.7	548.7	2469.4	2484.1	359.4
2240	2.30	515.16	88.9	548.9	2470.2	2484.9	359.4
2250	2.30	517.46	89.0	549.0	2471.0	2485.7	359.4
2260	2.30	519.76	89.1	549.1	2471.8	2486.5	359.4
2270	2.30	522.06	89.4	549.4	2472.6	2487.2	359.4
2280	2.30	524.36	89.5	549.5	2473.3	2488.0	359.3
2290	2.30	526.66	89.7	549.7	2474.1	2488.8	359.3
2300	2.30	528.96	89.8	549.8	2474.9	2489.6	359.4
2310	2.01	530.97	89.9	549.9	2475.7	2490.4	314.0
2320	2.01	532.98	90.1	550.1	2476.5	2491.2	314.0
2330	2.01	534.99	90.3	550.3	2477.3	2492.0	314.0
2340	2.01	537.00	90.3	550.3	2478.1	2492.8	314.0
2350	2.01	539.01	90.4	550.4	2478.9	2493.5	314.1
2360	2.01	541.02	90.5	550.5	2479.7	2494.3	314.1
2370	2.01	543.03	90.6	550.6	2480.4	2495.1	314.1
2380	2.01	545.04	90.8	550.8	2481.2	2495.9	314.1
2390	2.01	547.05	90.8	550.8	2482.0	2496.7	314.1
2400	2.01	549.06	91.0	551.0	2482.8	2497.5	314.1
2410	2.01	551.07	91.1	551.1	2483.6	2498.3	314.1
2420	2.01	553.08	91.2	551.2	2484.4	2499.1	314.2
2430	2.01	555.09	91.4	551.4	2485.2	2499.9	314.1
2440	2.01	557.10	91.5	551.5	2486.0	2500.7	314.1
2450	2.01	559.11	91.6	551.6	2486.8	2501.4	314.1
2460	2.01	561.12	91.7	551.7	2487.5	2502.2	314.2
2470	2.01	563.13	91.8	551.8	2488.3	2503.0	314.2
2480	2.01	565.14	91.7	551.7	2489.1	2503.8	314.3
2490	2.01	567.15	92.0	552.0	2489.9	2504.6	314.3
2500	2.01	569.16	92.2	552.2	2490.7	2505.4	314.3
2510	2.01	571.17	92.4	552.4	2491.5	2506.2	314.2
2520	2.01	573.18	92.5	552.5	2492.3	2507.0	314.2
2530	2.01	575.19	92.6	552.6	2493.1	2507.8	314.2
2540	2.01	577.20	92.7	552.7	2493.9	2508.5	314.2
2550	2.01	579.21	93.0	553.0	2494.7	2509.3	314.2
2560	2.01	581.22	93.2	553.2	2495.4	2510.1	314.1
2570	2.01	583.22	93.4	553.4	2496.2	2510.9	314.1
2580	2.01	585.23	93.5	553.5	2497.0	2511.7	314.1
2590	2.01	587.24	93.7	553.7	2497.8	2512.5	314.1
2600	2.01	589.25	93.8	553.8	2498.6	2513.3	314.1
2610	2.01	591.26	94.1	554.1	2499.4	2514.1	314.0



2620	2.01	593.27	94.4	554.4	2500.2	2514.9	313.9
2630	2.01	595.28	94.5	554.5	2501.0	2515.6	313.9
2640	2.01	597.29	94.6	554.6	2501.8	2516.4	313.9
2650	2.01	599.30	94.8	554.8	2502.5	2517.2	313.9
2660	2.01	601.31	95.0	555.0	2503.3	2518.0	313.8
2670	2.01	603.32	95.1	555.1	2504.1	2518.8	313.9
2680	2.01	605.33	95.2	555.2	2504.9	2519.6	313.9
2690	2.01	607.34	95.3	555.3	2505.7	2520.4	313.9
2700	2.01	609.35	95.4	555.4	2506.5	2521.2	313.9
2710	2.01	611.36	95.5	555.5	2507.3	2522.0	314.0
2720	2.01	613.37	95.6	555.6	2508.1	2522.7	314.0
2730	2.01	615.38	95.7	555.7	2508.8	2523.5	314.0
2740	2.01	617.39	96.1	556.1	2509.6	2524.3	313.9
2750	2.01	619.40	96.4	556.4	2510.4	2525.1	313.8
2760	2.01	621.41	96.4	556.4	2511.2	2525.9	313.8
2770	2.01	623.42	96.6	556.6	2512.0	2526.7	313.8
2780	2.01	625.43	96.8	556.8	2512.8	2527.5	313.8
2790	2.01	627.44	96.9	556.9	2513.6	2528.3	313.8
2800	2.01	629.45	97.2	557.2	2514.4	2529.0	313.7
2810	2.01	631.46	97.3	557.3	2515.2	2529.8	313.7
2820	2.01	633.47	97.4	557.4	2515.9	2530.6	313.7
2830	2.01	635.48	97.5	557.5	2516.7	2531.4	313.7
2840	2.01	637.49	97.6	557.6	2517.5	2532.2	313.8
2850	2.01	639.50	97.7	557.7	2518.3	2533.0	313.8
2860	2.01	641.51	97.9	557.9	2519.1	2533.8	313.7
2870	2.01	643.52	97.9	557.9	2519.9	2534.6	313.8
2880	2.01	645.52	98.0	558.0	2520.7	2535.4	313.8
2890	2.01	647.53	98.2	558.2	2521.5	2536.1	313.8
2900	2.01	649.54	98.3	558.3	2522.2	2536.9	313.8
2910	2.01	651.55	98.3	558.3	2523.0	2537.7	313.9
2920	2.01	653.56	98.4	558.4	2523.8	2538.5	313.9
2930	2.01	655.57	98.5	558.5	2524.6	2539.3	314.0
2940	2.01	657.58	98.5	558.5	2525.4	2540.1	314.0
2950	2.01	659.59	98.6	558.6	2526.2	2540.9	314.1
2960	2.01	661.60	98.8	558.8	2527.0	2541.7	314.1
2970	2.01	663.61	98.9	558.9	2527.8	2542.4	314.0
2980	2.01	665.62	99.3	559.3	2528.6	2543.2	314.0
2990	2.01	667.63	99.5	559.5	2529.3	2544.0	313.8
3000	2.01	669.64	99.9	559.9	2530.1	2544.8	313.8
3010	2.01	671.65	100.2	560.2	2530.9	2545.6	313.6
3020	2.01	673.66	100.4	560.4	2531.7	2546.4	313.5
3030	2.01	675.67	100.6	560.6	2532.5	2547.2	313.5
3040	2.01	677.68	100.9	560.9	2533.3	2548.0	313.4
3050	2.01	679.69	101.3	561.3	2534.1	2548.8	313.3
3060	2.01	681.70	101.3	561.3	2534.9	2549.5	313.3



3070	2.01	683.71	101.4	561.4	2535.6	2550.3	313.3
3080	2.01	685.72	101.8	561.8	2536.4	2551.1	313.2
3090	2.01	687.73	101.8	561.8	2537.2	2551.9	313.2
3100	2.01	689.74	102.2	562.2	2538.0	2552.7	313.1
3110	2.01	691.75	102.4	562.4	2538.8	2553.5	313.1
3120	2.01	693.76	102.7	562.7	2539.6	2554.3	313.0
3130	2.01	695.77	102.8	562.8	2540.4	2555.0	313.0
3140	2.01	697.78	103.0	563.0	2541.2	2555.8	313.0
3150	2.01	699.79	103.1	563.1	2541.9	2556.6	312.9
3160	2.01	701.80	103.3	563.3	2542.7	2557.4	312.9
3170	2.01	703.81	103.5	563.5	2543.5	2558.2	312.9
3180	2.01	705.82	103.7	563.7	2544.3	2559.0	312.8
3190	2.01	707.82	104.3	564.3	2545.1	2559.8	312.7
3200	2.01	709.83	104.5	564.5	2545.9	2560.5	312.5
3210	2.01	711.84	104.7	564.7	2546.7	2561.3	312.5
3220	2.01	713.85	105.3	565.3	2547.4	2562.1	312.3
3230	2.01	715.86	105.4	565.4	2548.2	2562.9	312.2
3240	2.01	717.87	105.7	565.7	2549.0	2563.7	312.1
3250	2.01	719.88	105.8	565.8	2549.8	2564.5	312.1
3260	2.01	721.89	106.1	566.1	2550.6	2565.3	312.0
3270	2.01	723.90	106.3	566.3	2551.4	2566.0	312.0
3280	2.01	725.91	106.4	566.4	2552.1	2566.8	311.9
3290	2.01	727.92	106.5	566.5	2552.9	2567.6	312.0
3300	2.01	729.93	106.7	566.7	2553.7	2568.4	312.0
3310	2.01	731.94	107.0	567.0	2554.5	2569.2	311.9
3320	2.01	733.95	107.0	567.0	2555.3	2570.0	311.9
3330	2.01	735.96	107.2	567.2	2556.1	2570.7	311.9
3340	2.01	737.97	107.2	567.2	2556.8	2571.5	312.0
3350	2.01	739.98	107.3	567.3	2557.6	2572.3	312.0
3360	2.01	741.99	107.4	567.4	2558.4	2573.1	312.0
3370	2.01	744.00	107.4	567.4	2559.2	2573.9	312.1
3380	2.01	746.01	107.4	567.4	2560.0	2574.7	312.1
3390	2.01	748.02	107.5	567.5	2560.8	2575.4	312.2
3400	2.01	750.03	107.5	567.5	2561.5	2576.2	312.3
3410	2.01	752.04	107.6	567.6	2562.3	2577.0	312.3
3420	2.01	754.05	107.5	567.5	2563.1	2577.8	312.4
3430	2.01	756.06	107.8	567.8	2563.9	2578.6	312.4
3440	2.01	758.07	107.6	567.6	2564.7	2579.4	312.5
3450	2.01	760.08	107.5	567.5	2565.5	2580.1	312.6
3460	2.01	762.09	107.6	567.6	2566.3	2580.9	312.7
3470	2.01	764.10	107.5	567.5	2567.0	2581.7	312.8
3480	2.01	766.11	107.5	567.5	2567.8	2582.5	312.9
3490	2.01	768.12	107.5	567.5	2568.6	2583.3	313.0
3500	2.01	770.12	107.4	567.4	2569.4	2584.1	313.2
3510	2.01	772.13	107.2	567.2	2570.2	2584.9	313.3



3520	2.01	774.14	106.6	566.6	2571.0	2585.7	313.6
3530	2.01	776.15	106.3	566.3	2571.8	2586.4	314.0
3540	2.01	778.16	105.7	565.7	2572.6	2587.2	314.4
3554.5	2.91	781.08	103.5	563.5	2573.7	2588.4	457.3
Total							121,748

Table D-2 Temperature and Nitrogen Data End Test CW-5

Depth (ft)	Volume (ft3)		Temperature		Pressure		Nitrogen (ft3) STP
	Incremental	Total	(°F)	(°R)	(psig)	psia)	
0	0	0	61.0	521.0	2295.0	2309.7	0.0
10	2.30	2.30	62.0	522.0	2295.8	2310.5	356.6
20	2.30	4.60	62.0	522.0	2296.6	2311.2	356.3
30	2.30	6.90	62.3	522.3	2297.3	2312.0	356.3
40	2.30	9.20	62.6	522.6	2298.1	2312.8	356.2
50	2.30	11.50	62.6	522.6	2298.9	2313.6	356.2
60	2.30	13.80	62.7	522.7	2299.7	2314.4	356.2
70	2.30	16.10	62.9	522.9	2300.5	2315.2	356.3
80	2.30	18.40	62.9	522.9	2301.3	2315.9	356.3
90	2.30	20.70	63.2	523.2	2302.0	2316.7	356.3
100	2.30	23.00	63.5	523.5	2302.8	2317.5	356.1
110	2.30	25.30	63.5	523.5	2303.6	2318.3	356.1
120	2.30	27.60	63.6	523.6	2304.4	2319.1	356.2
130	2.30	29.90	63.7	523.7	2305.2	2319.8	356.3
140	2.30	32.20	63.8	523.8	2305.9	2320.6	356.3
150	2.30	34.50	63.9	523.9	2306.7	2321.4	356.3
160	2.30	36.80	63.9	523.9	2307.5	2322.2	356.4
170	2.30	39.10	64.1	524.1	2308.3	2323.0	356.4
180	2.30	41.40	64.5	524.5	2309.1	2323.8	356.3
190	2.30	43.70	64.4	524.4	2309.9	2324.5	356.3
200	2.30	46.00	64.4	524.4	2310.6	2325.3	356.4
210	2.30	48.30	64.6	524.6	2311.4	2326.1	356.4
220	2.30	50.60	64.7	524.7	2312.2	2326.9	356.4
230	2.30	52.90	64.7	524.7	2313.0	2327.7	356.5
240	2.30	55.20	64.8	524.8	2313.8	2328.5	356.6
250	2.30	57.50	65.0	525.0	2314.6	2329.2	356.6
260	2.30	59.80	65.0	525.0	2315.3	2330.0	356.6
270	2.30	62.10	65.0	525.0	2316.1	2330.8	356.7
280	2.30	64.40	65.1	525.1	2316.9	2331.6	356.8
290	2.30	66.70	65.3	525.3	2317.7	2332.4	356.8
300	2.30	69.00	65.2	525.2	2318.5	2333.1	356.9
310	2.30	71.30	65.3	525.3	2319.3	2333.9	357.0
320	2.30	73.59	65.5	525.5	2320.0	2334.7	357.0
330	2.30	75.89	65.6	525.6	2320.8	2335.5	357.0
340	2.30	78.19	65.6	525.6	2321.6	2336.3	357.1
350	2.30	80.49	65.7	525.7	2322.4	2337.1	357.1
360	2.30	82.79	65.7	525.7	2323.2	2337.9	357.2
370	2.30	85.09	65.8	525.8	2324.0	2338.6	357.2
380	2.30	87.39	65.9	525.9	2324.7	2339.4	357.3
390	2.30	89.69	66.1	526.1	2325.5	2340.2	357.3



400	2.30	91.99	66.2	526.2	2326.3	2341.0	357.3
410	2.30	94.29	66.2	526.2	2327.1	2341.8	357.3
420	2.30	96.59	66.5	526.5	2327.9	2342.6	357.3
430	2.30	98.89	66.6	526.6	2328.7	2343.3	357.3
440	2.30	101.19	66.6	526.6	2329.4	2344.1	357.3
450	2.30	103.49	66.6	526.6	2330.2	2344.9	357.4
460	2.30	105.79	66.8	526.8	2331.0	2345.7	357.5
470	2.30	108.09	66.8	526.8	2331.8	2346.5	357.5
480	2.30	110.39	66.9	526.9	2332.6	2347.3	357.6
490	2.30	112.69	66.9	526.9	2333.4	2348.0	357.7
500	2.30	114.99	67.0	527.0	2334.2	2348.8	357.7
510	2.30	117.29	67.2	527.2	2334.9	2349.6	357.7
520	2.30	119.59	67.4	527.4	2335.7	2350.4	357.7
530	2.30	121.89	67.4	527.4	2336.5	2351.2	357.7
540	2.30	124.19	67.5	527.5	2337.3	2352.0	357.7
550	2.30	126.49	67.6	527.6	2338.1	2352.8	357.8
560	2.30	128.79	67.8	527.8	2338.9	2353.5	357.8
570	2.30	131.09	67.8	527.8	2339.7	2354.3	357.8
580	2.30	133.39	68.0	528.0	2340.4	2355.1	357.9
590	2.30	135.69	68.0	528.0	2341.2	2355.9	357.9
600	2.30	137.99	68.1	528.1	2342.0	2356.7	358.0
610	2.30	140.29	68.3	528.3	2342.8	2357.5	358.0
620	2.30	142.59	68.4	528.4	2343.6	2358.3	358.0
630	2.30	144.89	68.5	528.5	2344.4	2359.0	358.0
640	2.30	147.19	68.6	528.6	2345.2	2359.8	358.0
650	2.30	149.49	68.7	528.7	2345.9	2360.6	358.1
660	2.30	151.79	68.8	528.8	2346.7	2361.4	358.1
670	2.30	154.09	68.9	528.9	2347.5	2362.2	358.1
680	2.30	156.39	69.0	529.0	2348.3	2363.0	358.1
690	2.30	158.69	69.2	529.2	2349.1	2363.8	358.1
700	2.30	160.99	69.4	529.4	2349.9	2364.5	358.1
710	2.30	163.29	69.6	529.6	2350.7	2365.3	358.1
720	2.30	165.59	69.7	529.7	2351.4	2366.1	358.1
730	2.30	167.89	69.7	529.7	2352.2	2366.9	358.1
740	2.30	170.19	69.7	529.7	2353.0	2367.7	358.2
750	2.30	172.49	69.9	529.9	2353.8	2368.5	358.2
760	2.30	174.79	70.0	530.0	2354.6	2369.3	358.3
770	2.30	177.09	70.0	530.0	2355.4	2370.1	358.3
780	2.30	179.39	70.1	530.1	2356.2	2370.8	358.3
790	2.30	181.69	70.3	530.3	2356.9	2371.6	358.4
800	2.30	183.99	70.5	530.5	2357.7	2372.4	358.3
810	2.30	186.29	70.6	530.6	2358.5	2373.2	358.3
820	2.30	188.59	70.6	530.6	2359.3	2374.0	358.4
830	2.30	190.89	70.7	530.7	2360.1	2374.8	358.4
840	2.30	193.19	70.8	530.8	2360.9	2375.6	358.5





850	2.30	195.49	70.9	530.9	2361.7	2376.3	358.5
860	2.30	197.79	70.9	530.9	2362.5	2377.1	358.6
870	2.30	200.09	71.1	531.1	2363.2	2377.9	358.6
880	2.30	202.39	71.2	531.2	2364.0	2378.7	358.6
890	2.30	204.69	71.4	531.4	2364.8	2379.5	358.6
900	2.30	206.99	71.5	531.5	2365.6	2380.3	358.6
910	2.30	209.29	71.5	531.5	2366.4	2381.1	358.6
920	2.30	211.59	71.7	531.7	2367.2	2381.9	358.7
930	2.30	213.89	71.7	531.7	2368.0	2382.6	358.7
940	2.30	216.19	71.8	531.8	2368.7	2383.4	358.8
950	2.30	218.49	71.9	531.9	2369.5	2384.2	358.8
960	2.30	220.78	72.0	532.0	2370.3	2385.0	358.8
970	2.30	223.08	72.2	532.2	2371.1	2385.8	358.8
980	2.30	225.38	72.4	532.4	2371.9	2386.6	358.8
990	2.30	227.68	72.5	532.5	2372.7	2387.4	358.8
1000	2.30	229.98	72.5	532.5	2373.5	2388.2	358.8
1010	2.30	232.28	72.6	532.6	2374.3	2388.9	358.9
1020	2.30	234.58	72.8	532.8	2375.1	2389.7	358.9
1030	2.30	236.88	72.8	532.8	2375.8	2390.5	359.0
1040	2.30	239.18	72.9	532.9	2376.6	2391.3	359.0
1050	2.30	241.48	73.0	533.0	2377.4	2392.1	359.1
1060	2.30	243.78	73.1	533.1	2378.2	2392.9	359.1
1070	2.30	246.08	73.2	533.2	2379.0	2393.7	359.1
1080	2.30	248.38	73.5	533.5	2379.8	2394.5	359.1
1090	2.30	250.68	73.6	533.6	2380.6	2395.2	359.0
1100	2.30	252.98	73.7	533.7	2381.4	2396.0	359.1
1110	2.30	255.28	73.9	533.9	2382.1	2396.8	359.1
1120	2.30	257.58	74.0	534.0	2382.9	2397.6	359.0
1130	2.30	259.88	74.2	534.2	2383.7	2398.4	359.0
1140	2.30	262.18	74.5	534.5	2384.5	2399.2	359.0
1150	2.30	264.48	74.5	534.5	2385.3	2400.0	358.9
1160	2.30	266.78	74.6	534.6	2386.1	2400.8	359.0
1170	2.30	269.08	74.7	534.7	2386.9	2401.6	359.0
1180	2.30	271.38	74.9	534.9	2387.7	2402.3	359.0
1190	2.30	273.68	74.9	534.9	2388.4	2403.1	359.1
1200	2.30	275.98	75.0	535.0	2389.2	2403.9	359.1
1210	2.30	278.28	75.0	535.0	2390.0	2404.7	359.2
1220	2.30	280.58	75.1	535.1	2390.8	2405.5	359.3
1230	2.30	282.88	75.3	535.3	2391.6	2406.3	359.3
1240	2.30	285.18	75.5	535.5	2392.4	2407.1	359.2
1250	2.30	287.48	75.5	535.5	2393.2	2407.9	359.3
1260	2.30	289.78	75.6	535.6	2394.0	2408.6	359.3
1270	2.30	292.08	75.7	535.7	2394.8	2409.4	359.3
1280	2.30	294.38	75.9	535.9	2395.5	2410.2	359.3
1290	2.30	296.68	75.9	535.9	2396.3	2411.0	359.4



1300	2.30	298.98	76.0	536.0	2397.1	2411.8	359.4
1310	2.30	301.28	76.3	536.3	2397.9	2412.6	359.4
1320	2.30	303.58	76.5	536.5	2398.7	2413.4	359.3
1330	2.30	305.88	76.6	536.6	2399.5	2414.2	359.3
1340	2.30	308.18	76.7	536.7	2400.3	2415.0	359.4
1350	2.30	310.48	76.8	536.8	2401.1	2415.7	359.4
1360	2.30	312.78	76.9	536.9	2401.9	2416.5	359.4
1370	2.30	315.08	77.0	537.0	2402.6	2417.3	359.4
1380	2.30	317.38	77.3	537.3	2403.4	2418.1	359.4
1390	2.30	319.68	77.5	537.5	2404.2	2418.9	359.3
1400	2.30	321.98	77.6	537.6	2405.0	2419.7	359.3
1410	2.30	324.28	77.8	537.8	2405.8	2420.5	359.3
1420	2.30	326.58	78.0	538.0	2406.6	2421.3	359.2
1430	2.30	328.88	78.0	538.0	2407.4	2422.1	359.3
1440	2.30	331.18	78.3	538.3	2408.2	2422.8	359.3
1450	2.30	333.48	78.3	538.3	2409.0	2423.6	359.3
1460	2.30	335.78	78.4	538.4	2409.7	2424.4	359.3
1470	2.30	338.08	78.5	538.5	2410.5	2425.2	359.3
1480	2.30	340.38	78.5	538.5	2411.3	2426.0	359.4
1490	2.30	342.68	78.5	538.5	2412.1	2426.8	359.5
1500	2.30	344.98	78.6	538.6	2412.9	2427.6	359.6
1510	2.30	347.28	78.6	538.6	2413.7	2428.4	359.6
1520	2.30	349.58	78.8	538.8	2414.5	2429.2	359.7
1530	2.30	351.88	78.9	538.9	2415.3	2429.9	359.7
1540	2.30	354.18	79.1	539.1	2416.1	2430.7	359.7
1550	2.30	356.48	79.2	539.2	2416.8	2431.5	359.6
1560	2.30	358.78	79.5	539.5	2417.6	2432.3	359.6
1570	2.30	361.08	79.5	539.5	2418.4	2433.1	359.6
1580	2.30	363.38	79.5	539.5	2419.2	2433.9	359.7
1590	2.30	365.67	79.8	539.8	2420.0	2434.7	359.7
1600	2.30	367.97	79.9	539.9	2420.8	2435.5	359.6
1610	2.30	370.27	80.1	540.1	2421.6	2436.3	359.6
1620	2.30	372.57	80.4	540.4	2422.4	2437.1	359.5
1630	2.30	374.87	80.5	540.5	2423.2	2437.8	359.5
1640	2.30	377.17	80.6	540.6	2423.9	2438.6	359.5
1650	2.30	379.47	80.7	540.7	2424.7	2439.4	359.6
1660	2.30	381.77	80.8	540.8	2425.5	2440.2	359.6
1670	2.30	384.07	80.8	540.8	2426.3	2441.0	359.7
1680	2.30	386.37	80.9	540.9	2427.1	2441.8	359.7
1690	2.30	388.67	81.1	541.1	2427.9	2442.6	359.7
1700	2.30	390.97	81.4	541.4	2428.7	2443.4	359.6
1710	2.30	393.27	81.6	541.6	2429.5	2444.2	359.5
1720	2.30	395.57	81.7	541.7	2430.3	2444.9	359.5
1730	2.30	397.87	81.8	541.8	2431.1	2445.7	359.6
1740	2.30	400.17	81.9	541.9	2431.8	2446.5	359.6



1750	2.30	402.47	82.2	542.2	2432.6	2447.3	359.5
1760	2.30	404.77	82.4	542.4	2433.4	2448.1	359.5
1770	2.30	407.07	82.4	542.4	2434.2	2448.9	359.5
1780	2.30	409.37	82.6	542.6	2435.0	2449.7	359.5
1790	2.30	411.67	82.7	542.7	2435.8	2450.5	359.5
1800	2.30	413.97	82.8	542.8	2436.6	2451.3	359.5
1810	2.30	416.27	83.0	543.0	2437.4	2452.0	359.5
1820	2.30	418.57	83.3	543.3	2438.2	2452.8	359.5
1830	2.30	420.87	83.5	543.5	2438.9	2453.6	359.4
1840	2.30	423.17	83.6	543.6	2439.7	2454.4	359.4
1850	2.30	425.47	83.8	543.8	2440.5	2455.2	359.4
1860	2.30	427.77	84.0	544.0	2441.3	2456.0	359.3
1870	2.30	430.07	84.1	544.1	2442.1	2456.8	359.3
1880	2.30	432.37	84.4	544.4	2442.9	2457.6	359.2
1890	2.30	434.67	84.6	544.6	2443.7	2458.4	359.2
1900	2.30	436.97	84.7	544.7	2444.5	2459.1	359.2
1910	2.30	439.27	84.9	544.9	2445.3	2459.9	359.2
1920	2.30	441.57	85.1	545.1	2446.0	2460.7	359.1
1930	2.30	443.87	85.1	545.1	2446.8	2461.5	359.1
1940	2.30	446.17	85.3	545.3	2447.6	2462.3	359.2
1950	2.30	448.47	85.4	545.4	2448.4	2463.1	359.1
1960	2.30	450.77	85.5	545.5	2449.2	2463.9	359.2
1970	2.30	453.07	85.7	545.7	2450.0	2464.7	359.2
1980	2.30	455.37	85.7	545.7	2450.8	2465.5	359.2
1990	2.30	457.67	85.8	545.8	2451.6	2466.2	359.2
2000	2.30	459.97	85.9	545.9	2452.3	2467.0	359.3
2010	2.30	462.27	86.1	546.1	2453.1	2467.8	359.3
2020	2.30	464.57	86.1	546.1	2453.9	2468.6	359.3
2030	2.30	466.87	86.4	546.4	2454.7	2469.4	359.3
2040	2.30	469.17	86.4	546.4	2455.5	2470.2	359.3
2050	2.30	471.47	86.6	546.6	2456.3	2471.0	359.3
2060	2.30	473.77	86.7	546.7	2457.1	2471.8	359.3
2070	2.30	476.07	86.9	546.9	2457.9	2472.5	359.3
2080	2.30	478.37	87.0	547.0	2458.7	2473.3	359.3
2090	2.30	480.67	87.4	547.4	2459.4	2474.1	359.2
2100	2.30	482.97	87.6	547.6	2460.2	2474.9	359.1
2110	2.30	485.27	87.9	547.9	2461.0	2475.7	359.0
2120	2.30	487.57	88.1	548.1	2461.8	2476.5	358.9
2130	2.30	489.87	88.4	548.4	2462.6	2477.3	358.8
2140	2.30	492.17	88.6	548.6	2463.4	2478.1	358.8
2150	2.30	494.47	88.5	548.5	2464.2	2478.9	358.8
2160	2.30	496.77	88.6	548.6	2465.0	2479.6	358.9
2170	2.30	499.07	88.7	548.7	2465.7	2480.4	358.9
2180	2.30	501.37	88.9	548.9	2466.5	2481.2	358.9
2190	2.30	503.67	89.0	549.0	2467.3	2482.0	358.9



2200	2.30	505.97	89.2	549.2	2468.1	2482.8	358.9
2210	2.30	508.27	89.2	549.2	2468.9	2483.6	358.9
2220	2.30	510.56	89.3	549.3	2469.7	2484.4	359.0
2230	2.30	512.86	89.4	549.4	2470.5	2485.2	359.1
2240	2.30	515.16	89.4	549.4	2471.3	2485.9	359.1
2250	2.30	517.46	89.5	549.5	2472.1	2486.7	359.2
2260	2.30	519.76	89.6	549.6	2472.8	2487.5	359.2
2270	2.30	522.06	89.8	549.8	2473.6	2488.3	359.2
2280	2.30	524.36	89.8	549.8	2474.4	2489.1	359.2
2290	2.30	526.66	90.0	550.0	2475.2	2489.9	359.3
2300	2.30	528.96	90.1	550.1	2476.0	2490.7	359.2
2310	2.01	530.97	90.5	550.5	2476.8	2491.5	313.8
2320	2.01	532.98	90.6	550.6	2477.6	2492.3	313.8
2330	2.01	534.99	90.6	550.6	2478.4	2493.0	313.8
2340	2.01	537.00	90.6	550.6	2479.1	2493.8	313.9
2350	2.01	539.01	90.7	550.7	2479.9	2494.6	314.0
2360	2.01	541.02	90.8	550.8	2480.7	2495.4	314.0
2370	2.01	543.03	91.0	551.0	2481.5	2496.2	314.0
2380	2.01	545.04	91.1	551.1	2482.3	2497.0	314.0
2390	2.01	547.05	91.1	551.1	2483.1	2497.8	314.0
2400	2.01	549.06	91.3	551.3	2483.9	2498.6	314.0
2410	2.01	551.07	91.5	551.5	2484.7	2499.4	314.0
2420	2.01	553.08	91.6	551.6	2485.5	2500.1	314.0
2430	2.01	555.09	91.6	551.6	2486.2	2500.9	314.1
2440	2.01	557.10	91.7	551.7	2487.0	2501.7	314.1
2450	2.01	559.11	91.9	551.9	2487.8	2502.5	314.1
2460	2.01	561.12	91.9	551.9	2488.6	2503.3	314.1
2470	2.01	563.13	92.1	552.1	2489.4	2504.1	314.1
2480	2.01	565.14	92.3	552.3	2490.2	2504.9	314.1
2490	2.01	567.15	92.4	552.4	2491.0	2505.7	314.1
2500	2.01	569.16	92.5	552.5	2491.8	2506.5	314.1
2510	2.01	571.17	92.7	552.7	2492.6	2507.2	314.1
2520	2.01	573.18	92.9	552.9	2493.4	2508.0	314.1
2530	2.01	575.19	93.3	553.3	2494.1	2508.8	314.0
2540	2.01	577.20	93.3	553.3	2494.9	2509.6	313.9
2550	2.01	579.21	93.4	553.4	2495.7	2510.4	314.0
2560	2.01	581.22	93.6	553.6	2496.5	2511.2	314.0
2570	2.01	583.22	93.8	553.8	2497.3	2512.0	314.0
2580	2.01	585.23	94.0	554.0	2498.1	2512.8	313.9
2590	2.01	587.24	94.0	554.0	2498.9	2513.6	314.0
2600	2.01	589.25	94.4	554.4	2499.7	2514.3	313.9
2610	2.01	591.26	94.5	554.5	2500.4	2515.1	313.8
2620	2.01	593.27	94.8	554.8	2501.2	2515.9	313.8
2630	2.01	595.28	95.1	555.1	2502.0	2516.7	313.7
2640	2.01	597.29	95.4	555.4	2502.8	2517.5	313.6



2650	2.01	599.30	95.4	555.4	2503.6	2518.3	313.6
2660	2.01	601.31	95.6	555.6	2504.4	2519.1	313.6
2670	2.01	603.32	95.6	555.6	2505.2	2519.9	313.6
2680	2.01	605.33	95.7	555.7	2506.0	2520.6	313.7
2690	2.01	607.34	95.8	555.8	2506.8	2521.4	313.7
2700	2.01	609.35	96.0	556.0	2507.5	2522.2	313.7
2710	2.01	611.36	96.2	556.2	2508.3	2523.0	313.6
2720	2.01	613.37	96.4	556.4	2509.1	2523.8	313.6
2730	2.01	615.38	96.5	556.5	2509.9	2524.6	313.6
2740	2.01	617.39	96.7	556.7	2510.7	2525.4	313.6
2750	2.01	619.40	96.8	556.8	2511.5	2526.2	313.6
2760	2.01	621.41	97.1	557.1	2512.3	2526.9	313.5
2770	2.01	623.42	97.4	557.4	2513.1	2527.7	313.4
2780	2.01	625.43	97.5	557.5	2513.8	2528.5	313.4
2790	2.01	627.44	97.6	557.6	2514.6	2529.3	313.4
2800	2.01	629.45	97.7	557.7	2515.4	2530.1	313.4
2810	2.01	631.46	97.9	557.9	2516.2	2530.9	313.4
2820	2.01	633.47	98.0	558.0	2517.0	2531.7	313.4
2830	2.01	635.48	98.3	558.3	2517.8	2532.5	313.4
2840	2.01	637.49	98.3	558.3	2518.6	2533.2	313.4
2850	2.01	639.50	98.5	558.5	2519.4	2534.0	313.4
2860	2.01	641.51	98.5	558.5	2520.1	2534.8	313.4
2870	2.01	643.52	98.7	558.7	2520.9	2535.6	313.4
2880	2.01	645.52	98.7	558.7	2521.7	2536.4	313.5
2890	2.01	647.53	98.8	558.8	2522.5	2537.2	313.5
2900	2.01	649.54	98.8	558.8	2523.3	2538.0	313.6
2910	2.01	651.55	98.9	558.9	2524.1	2538.8	313.6
2920	2.01	653.56	98.9	558.9	2524.9	2539.5	313.7
2930	2.01	655.57	99.1	559.1	2525.7	2540.3	313.7
2940	2.01	657.58	99.2	559.2	2526.4	2541.1	313.7
2950	2.01	659.59	99.4	559.4	2527.2	2541.9	313.7
2960	2.01	661.60	99.5	559.5	2528.0	2542.7	313.7
2970	2.01	663.61	99.7	559.7	2528.8	2543.5	313.7
2980	2.01	665.62	100.0	560.0	2529.6	2544.3	313.6
2990	2.01	667.63	100.3	560.3	2530.4	2545.1	313.5
3000	2.01	669.64	100.5	560.5	2531.2	2545.8	313.4
3010	2.01	671.65	100.9	560.9	2532.0	2546.6	313.3
3020	2.01	673.66	101.3	561.3	2532.7	2547.4	313.1
3030	2.01	675.67	101.5	561.5	2533.5	2548.2	313.1
3040	2.01	677.68	101.7	561.7	2534.3	2549.0	313.0
3050	2.01	679.69	101.9	561.9	2535.1	2549.8	313.0
3060	2.01	681.70	102.3	562.3	2535.9	2550.6	312.9
3070	2.01	683.71	102.4	562.4	2536.7	2551.4	312.8
3080	2.01	685.72	102.6	562.6	2537.5	2552.1	312.8
3090	2.01	687.73	102.9	562.9	2538.2	2552.9	312.7



3100	2.01	689.74	103.3	563.3	2539.0	2553.7	312.6
3110	2.01	691.75	103.4	563.4	2539.8	2554.5	312.5
3120	2.01	693.76	103.4	563.4	2540.6	2555.3	312.6
3130	2.01	695.77	103.6	563.6	2541.4	2556.1	312.6
3140	2.01	697.78	103.8	563.8	2542.2	2556.8	312.6
3150	2.01	699.79	104.0	564.0	2543.0	2557.6	312.5
3160	2.01	701.80	104.2	564.2	2543.7	2558.4	312.5
3170	2.01	703.81	104.3	564.3	2544.5	2559.2	312.5
3180	2.01	705.82	104.6	564.6	2545.3	2560.0	312.4
3190	2.01	707.82	105.0	565.0	2546.1	2560.8	312.3
3200	2.01	709.83	105.4	565.4	2546.9	2561.6	312.1
3210	2.01	711.84	105.8	565.8	2547.7	2562.3	311.9
3220	2.01	713.85	106.2	566.2	2548.4	2563.1	311.8
3230	2.01	715.86	106.5	566.5	2549.2	2563.9	311.6
3240	2.01	717.87	106.6	566.6	2550.0	2564.7	311.6
3250	2.01	719.88	106.8	566.8	2550.8	2565.5	311.6
3260	2.01	721.89	107.2	567.2	2551.6	2566.3	311.5
3270	2.01	723.90	107.3	567.3	2552.4	2567.0	311.4
3280	2.01	725.91	107.4	567.4	2553.1	2567.8	311.4
3290	2.01	727.92	107.5	567.5	2553.9	2568.6	311.5
3300	2.01	729.93	107.7	567.7	2554.7	2569.4	311.5
3310	2.01	731.94	107.8	567.8	2555.5	2570.2	311.5
3320	2.01	733.95	107.9	567.9	2556.3	2570.9	311.5
3330	2.01	735.96	107.9	567.9	2557.1	2571.7	311.5
3340	2.01	737.97	107.9	567.9	2557.8	2572.5	311.6
3350	2.01	739.98	108.0	568.0	2558.6	2573.3	311.6
3360	2.01	741.99	108.1	568.1	2559.4	2574.1	311.7
3370	2.01	744.00	108.1	568.1	2560.2	2574.9	311.8
3380	2.01	746.01	108.3	568.3	2561.0	2575.6	311.8
3390	2.01	748.02	108.3	568.3	2561.7	2576.4	311.8
3400	2.01	750.03	108.3	568.3	2562.5	2577.2	311.9
3410	2.01	752.04	108.3	568.3	2563.3	2578.0	311.9
3420	2.01	754.05	108.4	568.4	2564.1	2578.8	312.0
3430	2.01	756.06	108.3	568.3	2564.9	2579.6	312.1
3440	2.01	758.07	108.4	568.4	2565.7	2580.3	312.2
3450	2.01	760.08	108.4	568.4	2566.5	2581.1	312.2
3460	2.01	762.09	108.3	568.3	2567.2	2581.9	312.3
3470	2.01	764.10	108.2	568.2	2568.0	2582.7	312.5
3480	2.01	766.11	108.1	568.1	2568.8	2583.5	312.6
3490	2.01	768.12	107.9	567.9	2569.6	2584.3	312.8
3500	2.01	770.12	107.6	567.6	2570.4	2585.1	313.1
3510	2.01	772.13	107.4	567.4	2571.2	2585.8	313.3
3520	2.01	774.14	107.0	567.0	2572.0	2586.6	313.6
3530	2.01	776.15	106.6	566.6	2572.7	2587.4	313.9
3540	2.01	778.16	105.6	565.6	2573.5	2588.2	314.5



3552	2.41	780.58	102.8	562.8	2574.5	2589.2	378.9
Total							121,665



## Appendix D Calibration Papers for Pressure Recorders



1010 West Bagley Road  
Berea, OH 44017  
Phone: 440-243-0888  
Fax: 440-243-3472

## PRESSURE TRANSDUCER CALIBRATION RECORD

**CUSTOMER:** Advanced Air Products  
6477 South Cottonwood Street  
Murray, UT 84107

**Purchase Order** 6095587  
**Sales Order No.** 321469  
**Cal Date** 07-13-15  
**Cal Due Date**  
**Serial #** N75816

Traceable to N.I.S.T.

<b>Item:</b>	621-3000-1-1-8-6	<b>Accuracy (BFSL) <math>\pm</math> 0.25 %</b>
--------------	------------------	--

<b>CALIBRATION STANDARD:</b> Agilent 34401A			
	<b>S/N</b>	<b>CAL. DATE</b>	<b>CAL. DUE DATE</b>
	US36134775	08-01-14	08-01-15
<b>CALIBRATION STANDARD:</b> Fluke RPM4			
	<b>S/N</b>	<b>CAL. DATE</b>	<b>CAL. DUE DATE</b>
	1623	12-21-14	12-21-15

Note: The aforementioned calibration standard is at least four times as accurate as the instrument being tested.

<b>Power Supply:</b>	24 VDC
----------------------	--------

STANDARD	OUTPUT	STANDARD	OUTPUT
0 PSI	3.982 mA	2400 PSI	16.782 mA
600	7.183	1800	13.581
1200	10.383	1200	10.381
1800	13.582	600	7.180
2400	16.782	0	3.980
3000	19.982		

Certified Correct By:

*Brian Salaf*

Verified By:

*Brian Salaf*

Lab Temperature: 70°F  $\pm$  7°F

Lab Humidity: 20% to 70% R.H.

PTCR0504



1010 West Bagley Road  
Berea, OH 44017  
Phone: 440-243-0888  
Fax: 440-243-3472

## PRESSURE TRANSDUCER CALIBRATION RECORD

**CUSTOMER:** Advanced Air Products

6477 South Cottonwood Street  
Murray, UT 84107

**Purchase Order** 6095587

**Sales Order No.** 321469

**Cal Date** 07-13-15

**Cal Due Date**

**Serial #** N75817

*Traceable to N.I.S.T.*

<b>Item:</b>	621-3000-1-1-8-6	<b>Accuracy (BFSL) <math>\pm</math> 0.25 %</b>
--------------	------------------	--

<b>CALIBRATION STANDARD:</b> Agilent 34401A			
	<b>S/N</b>	<b>CAL. DATE</b>	<b>CAL. DUE DATE</b>
	US36134775	08-01-14	08-01-15
<b>CALIBRATION STANDARD:</b> Fluke RPM4			
	<b>S/N</b>	<b>CAL. DATE</b>	<b>CAL. DUE DATE</b>
	1623	12-21-14	12-21-15

Note: The aforementioned calibration standard is at least four times as accurate as the instrument being tested.

<b>Power Supply:</b>	24 VDC
----------------------	--------

STANDARD	OUTPUT	STANDARD	OUTPUT
0 PSI	3.984 mA	2400 PSI	16.788 mA
600	7.184	1800	13.587
1200	10.386	1200	10.386
1800	12.587	600	7.184
2400	16.588	0	3.982
3000	19.988		

Certified Correct By:

*Brian Salol*

Verified By:

*Bar Bar*

Lab Temperature: 70°F  $\pm$  7°F

Lab Humidity: 20% to 70% R.H.

PTCR0504



## Appendix E Utah UIC Forms



### Nitrogen / Brine Interface Test Field Procedure Report

Guideline #:

UIC-3-16

(February 2014)

#### Narrative

The following field procedure report for the nitrogen / brine interface test must be completed and submitted with the final test report (UIC-3-17). This field procedure report template is taken, with permission, from the Kansas Underground Hydrocarbon Storage Unit.

Type of MIT:	Well Casing	Cavern	<b>Well Casing and Cavern</b>	(circle)
Facility: Sawtooth NGL Delta, Utah			Well: CW-5	

<b>TEST PREPARATION</b>	Date / Time: April 10, 2016
Wellhead inspection results: Describe external corrosion, faulty valves, gasket leaks, verification of adequate fittings for wireline equipment and nitrogen injection, installation of accurate electronic pressure instrumentation on tubing and annulus, etc. New wellhead – all components in good shape. Wellhead and valves rated for 3000 psi. Recorder for MIT pressures attached to brine annulus and nitrogen annulus spools.	
Removal of product	Date / Time: Removed from March 1 to April 7, 2016

<b>PRE-PRESSURIZATION</b>	Date / Time: April 10		
Annulus pressure:	850	Tubing pressure:	850
Cavern compressibility: 5.4 bbl/psi			
Cavern Pressure (P) Stabilization:	P change < 10 psi/day? <b>Yes</b> / No Record P change / day: Pressure increased 1.5 psi/day		Duration of Stabilization Period: 9 days

<b>PRE-NITROGEN INJECTION</b>
-------------------------------



Nitrogen 'cool down' volume	N/A	
Baseline temperature log (from surface to 50 ft below expected interface)	Date / Time: 4/19/16 11:30 am	Temperature (F): Average 83.6°. Interface 104°
Baseline Temperature Log logging speed:	25 fpm	
Baseline Sonic Log (a minimum of 50 ft below the expected interface level or an acceptable depth above the casing seat)	Date / Time: 4/20/16 4:30 pm	Interface depth: 3550 feet
		Anomalies (washouts, etc.) None
Baseline Sonic Log logging speed:	60 fpm	

## PART I: CASING TEST

Interval Depth	Nitrogen Pressure	Brine Pressure	Nitrogen Temperature	Time nitrogen interface passed
0 to 3312	2130	810	71 (surface)	2:38 PM

Measure nitrogen with a meter. Terminate nitrogen injection when the interface depth is just above the casing seat. If multiple intervals are to be tested, test intervals from shallow to deep.

CASING TEST		
Interval 1	0 to 3312 feet	
TEST START	Time:	4/20/16 2:38 PM
	Interface depth:	3312



	<i>Nitrogen pressure:</i>	2130	
	<i>Brine pressure:</i>	810	
TEST END	<i>Time:</i>	4/20/16/3:38 pm	
	<i>Length of test:</i>	60 minutes	
Sonic Log	<i>Interface depth:</i> 3312	<i>Brine pressure:</i> 810	<i>Nitrogen pressure:</i> 2130
Temperature Log Interval logged:	<i>Time:</i>		
	<i>Maximum temperature:</i>	108	
	<i>Average temperature:</i>	83	
	<i>Surface temperature:</i>	58	
Comments: Note any interface movement or loss of nitrogen pressure No change in interface depth or pressures.			

## PART II: CAVERN TEST

<b>Cavern Test</b>	
<b>Resume nitrogen injection</b>	Record surface pressures and time the interface crosses the casing seat
	<b>Brine pressure: 816</b>
	<b>Nitrogen pressure: 2295</b>
	<b>Time: 4/21/16 1036</b>
<b>Set interface below the casing and terminate nitrogen injection</b>	
<b>Log interface with sonic log</b>	<b>Interface depth: 3554.5 feet</b>



Brine pressure: 939.6		Nitrogen pressure: 2295	
Temperature log over test interval		Comments: average temperature 83.6°	
START TEST			
Calculate initial nitrogen volume at start of test: 139.1 bbls			
Test period		Length: 24 hours	
Monitor brine and nitrogen pressures during test			
Time: 4/21/16 1800		Brine: 818	Nitrogen: 2297
Time: 4/21/16 2300		Brine: 818	Nitrogen: 2293
Time: 4/22/16 0600		Brine: 816	Nitrogen: 2292
Time: 4/22/16 1000		Brine: 815	Nitrogen: 2294
Time – Final: 4/22/16 1013		Brine: 816	Nitrogen: 2295
Final Sonic log:		Depth: 3552.0 feet	
Final Temperature log:		Comments: Average temperature 83.9°	
Final nitrogen volume:		139.0 bbls	

**Comments:**Supervised by: (Print name) **Thomas Eyermann**

**Company/Title:**  
**Consultant**

**Signature:**

Date: 4/23/16

A rectangular box containing a handwritten signature in dark ink. The signature is stylized, appearing to be 'JH' or similar initials.

### References

Kansas Department of Health and Environment, Bureau of Water, Geology Section, Underground Hydrocarbon Storage Unit <http://www.kdheks.gov/uhs/>

Bérest P, Brouard B, Durup G. 2001. Tightness tests in salt-cavern wells. Oil & Gas Science and Technology. 56:451-469.





## Nitrogen / Brine Interface Test Final Report

Guideline #:

UIC-3-17

(February 2014)

### Narrative

Submit to the Utah Division of Water Quality the final report of the nitrogen / brine interface test following the format below. This final report template is taken, with permission, from the Kansas Underground Hydrocarbon Storage Unit.

Test Results	
Show formula and calculation for MDLR: MDLR=V*R*365/T MDLR= .20 * 0.5 *365/ 1 = 40.1 Bbl/Year Nitrogen	Compare MDLR and NLR: The NLR is less than the MDLR. The MDLR is less than the required 100 bbl/year detectable leak rate. The test is good
Show formula and calculation for nitrogen leak rate (NLR): =1/T*(VS-(VF*PF*RF/PS*RS)*365 NLR=1/1*(139.1-(139.0 *2295.*543.8)/2294 *543.5)*365 NLR=-13.6 bbl/year nitrogen	
Explain any interface movement during the test: During the temperature stabilization period the interface moved downhole, probably due to a combination of temperature equilibrium and mixing effects between the nitrogen and butane. During the test the interface moved uphole about 2.25 feet, but this equates to very little nitrogen volume change.	
Discuss the relationship of pressure trends to cavern integrity: The pressure trend taken in combination with the small temperature increase during the test indicate the well is tight.	
Discuss temperature stability and any accompanying effect on the MIT: The temperature during the test period changed by less than ½ degree and did not impact the MIT.	



Discuss pressure changes in adjacent caverns. Attach a chart or a graph.  
No adjacent caverns were recorded as they are in active use.

**Summarize test results:**

The test showed the well to have a minimum detectable leak rate (MDLR) of about 80 barrels/year. The apparent leak rate as measured during the test at about 13 barrels per year is below the MDLR. The well has no measurable leak rate.

Submit field procedure report (UIC-3- 16)

Submit all logs.

Submit supporting data, including graphs for stabilization, temperatures, pressures, injection, etc. Submit appropriate charts.

Submit calibration charts for gauges and meters.

## References

Kansas Department of Health and Environment, Bureau of Water, Geology Section, Underground Hydrocarbon Storage Unit <http://www.kdheks.gov/uhs/>

Bérest P, Brouard B, Durup G. 2001. Tightness tests in salt-cavern wells. Oil & Gas Science and Technology. 56:451-469.



## **Appendix F Interface logs for CW-5 MIT**

<b>STATE OF UTAH</b> DEPARTMENT OF NATURAL RESOURCES DIVISION OF OIL, GAS, AND MINING		<b>FORM 9</b>
<b>SUNDRY NOTICES AND REPORTS ON WELLS</b>  Do not use this form for proposals to drill new wells, significantly deepen existing wells below current bottom-hole depth, reenter plugged wells, or to drill horizontal laterals. Use APPLICATION FOR PERMIT TO DRILL form for such proposals.		<b>5. LEASE DESIGNATION AND SERIAL NUMBER:</b> 51573-OBA
<b>1. TYPE OF WELL</b> Gas Storage Well		<b>6. IF INDIAN, ALLOTTEE OR TRIBE NAME:</b>
<b>2. NAME OF OPERATOR:</b> NGL SUPPLY TERMINAL SOLUTION MINING, LLC		<b>7. UNIT or CA AGREEMENT NAME:</b>
<b>3. ADDRESS OF OPERATOR:</b> 6965 Union Park Avenue, Suite 270, Midvale, UT, 84047		<b>8. WELL NAME and NUMBER:</b> CW-5
<b>4. LOCATION OF WELL</b> <b>FOOTAGES AT SURFACE:</b> 0147 FSL 0167 FWL <b>QTR/QTR, SECTION, TOWNSHIP, RANGE, MERIDIAN:</b> Qtr/Qtr: SWSW Section: 23 Township: 15.0S Range: 07.0W Meridian: S		<b>9. API NUMBER:</b> 43027500020000
<b>PHONE NUMBER:</b> 801 255-9632 Ext		<b>9. FIELD and POOL or WILDCAT:</b> DELTA SALT CAVERN STORAGE
<b>COUNTY:</b> MILLARD		<b>STATE:</b> UTAH

11. CHECK APPROPRIATE BOXES TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION		
<input checked="" type="checkbox"/> <b>NOTICE OF INTENT</b> Approximate date work will start: <b>9/26/2016</b>	<input type="checkbox"/> ACIDIZE <input type="checkbox"/> CHANGE TO PREVIOUS PLANS <input type="checkbox"/> CHANGE WELL STATUS <input type="checkbox"/> DEEPEN <input type="checkbox"/> OPERATOR CHANGE <input type="checkbox"/> PRODUCTION START OR RESUME <input type="checkbox"/> REPERFORATE CURRENT FORMATION <input type="checkbox"/> TUBING REPAIR <input type="checkbox"/> WATER SHUTOFF <input type="checkbox"/> WILDCAT WELL DETERMINATION	<input type="checkbox"/> ALTER CASING <input type="checkbox"/> CHANGE TUBING <input type="checkbox"/> COMMINGLE PRODUCING FORMATIONS <input type="checkbox"/> FRACTURE TREAT <input type="checkbox"/> PLUG AND ABANDON <input type="checkbox"/> RECLAMATION OF WELL SITE <input type="checkbox"/> SIDETRACK TO REPAIR WELL <input type="checkbox"/> VENT OR FLARE <input type="checkbox"/> SI TA STATUS EXTENSION	<input type="checkbox"/> CASING REPAIR <input type="checkbox"/> CHANGE WELL NAME <input type="checkbox"/> CONVERT WELL TYPE <input type="checkbox"/> NEW CONSTRUCTION <input type="checkbox"/> PLUG BACK <input type="checkbox"/> RECOMPLETE DIFFERENT FORMATION <input type="checkbox"/> TEMPORARY ABANDON <input type="checkbox"/> WATER DISPOSAL <input type="checkbox"/> APD EXTENSION
<input type="checkbox"/> <b>SUBSEQUENT REPORT</b> Date of Work Completion:			
<input type="checkbox"/> <b>SPUD REPORT</b> Date of Spud:			
<input type="checkbox"/> <b>DRILLING REPORT</b> Report Date:			
	OTHER: <span style="border: 1px solid black; padding: 2px;">Drilling Mud Pit Closure</span>		

12. DESCRIBE PROPOSED OR COMPLETED OPERATIONS. Clearly show all pertinent details including dates, depths, volumes, etc.  
 Closure of Mud Pit from drilling operations. Pit will be emptied of any water, liner will be perforated and/or shredded, and pit will be filled with native soil to previous grade.

Approved by the  
October 27, 2016  
Oil, Gas and Mining

Date: \_\_\_\_\_

By:

<b>NAME (PLEASE PRINT)</b> Adam Richins	<b>PHONE NUMBER</b> 801 255-9632	<b>TITLE</b> Compliance Manager
<b>SIGNATURE</b> N/A	<b>DATE</b> 9/23/2016	